CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS

PROPOSED DIESEL PARTICULATE MATTER CONTROL MEASURE FOR ON-ROAD HEAVY-DUTY DIESEL-FUELED VEHICLES OWNED OR OPERATED BY PUBLIC AGENCIES AND UTILITIES

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California Environmental Protection Agency
AIR RESOURCES BOARD

PROPOSED DIESEL PARTICULATE MATTER CONTROL MEASURE FOR ON-ROAD HEAVY-DUTY DIESEL-FUELED VEHICLES OWNED OR OPERATED BY PUBLIC AGENCIES AND UTILITIES

Staff Report

October 2005

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LIST OF ACRONYMS

$/lb	Dollars per pound
AB	Assembly bill
ARB, or the Board	Air Resources Board
ATCM	Air toxic control measure
BACT	Best available control technology
CCR	California Code of Regulations
CO	Carbon monoxide
DECS	Diesel Emission Control System or Strategy
DOC	Diesel Oxidation Catalyst
DRRP, or Diesel Risk Reduction Plan	Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles Risk Reduction Plan
DTSC	Department of Toxic Substances Control
g/bhp-hr	Grams per brake horsepower-hour
GVWR	Gross vehicle weight rating
HC	Hydrocarbon
H&SC	Health and Safety Code
$\mu g/m^3$	Microgram per cubic meter
MY	Model year
Moyer Program	Carl Moyer Memorial Air Quality Standards Attainment Program
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NOV	Notice of violation
OEHHA	Office of Environmental Health Hazard Assessment
O & M	Operation and maintenance
PM	Particulate matter
Ppmw	Parts per million by weight
SCAQMD	South Coast Air Quality Management District
SJVAPCD	San Joaquin Valley Air Pollution Control District
TAC	Toxic air contaminant
Tpd	Tons per day
Ultra low sulfur diesel fuel	Diesel fuel with less than 15 ppmw sulfur content
U. S. EPA	United States Environmental Protection Agency
VIN	Vehicle identification number
VOC	Volatile organic compound

EXECUTIVE SUMMARY

The Air Resources Board's (ARB or Board) mission is to provide healthful air to all Californians. In 1998, the Board identified diesel particulate matter (PM) as a toxic air contaminant and established a goal of reducing emissions of diesel PM to the lowest practicable levels. Diesel PM is by far the largest contributor to adverse health impacts from all toxic air contaminants identified, comprising 70% of statewide risk.

In 2000, the Board adopted a comprehensive plan to reduce PM emissions from diesel-fueled engines and vehicles (ARB 2000b). The ARB has already adopted several control measures recommended in that plan, including rules for transit buses, solid waste collection vehicles, stationary engines, diesel portable equipment, transportation refrigeration units, idling controls, new cleaner exhaust standards for heavy-duty trucks and off-road equipment, and ultra-low sulfur diesel fuel in mid-2006.

The Diesel Risk Reduction Plan included control measures for on-road public fleets and other public and private fleets. This proposed regulation will meet that commitment. It will reduce ambient PM levels and exposure to primary and secondary diesel PM, in turn, reducing the prevalence of the diseases attributed to PM and diesel PM including hospitalizations for cardio-respiratory disease, and premature deaths. ARB staff estimates that approximately 37 deaths would be avoided by the year 2020 as a result of cumulative emission reductions obtained through this regulation.

The ARB staff recommends that the Board adopt new sections 2022 and 2022.1 in Title 13, California Code of Regulations (CCR), as set forth in the proposed Regulation Order in Appendix A.

I. INTRODUCTION

The Air Resources Board's (ARB or Board) mission is to provide clean healthful air to all Californians. In 1998, the Board identified diesel particulate matter (PM) as a toxic air contaminant and established a goal of reducing emissions of diesel PM to the lowest practicable levels. Diesel PM is the largest contributor to adverse health impacts from all toxic air contaminants identified thus far, comprising 70% of statewide risk.

In 2000, the Board adopted the "Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles" (Diesel Risk Reduction Plan) at a public meeting. Among other objectives, the Plan directs staff to develop "new retrofit requirements for existing on-road, off-road, and stationary diesel-fueled engines and vehicles where determined technically feasible and cost-effective."

The ARB has already adopted several of the recommended control measures, including rules for transit buses, solid waste collection vehicles, stationary engines, diesel portable equipment, transportation refrigeration units, idling controls, 2007 model year (MY) emission standards for heavy-duty trucks and off-road equipment, and ultra-low sulfur diesel fuel in mid-2006.

The Diesel Risk Reduction Plan included a specific commitment to develop control measures for on-road public fleets and other public and private fleets. The proposed regulations are part of ARB's continuing efforts to implement the Plan and reduce the public's exposure to harmful diesel PM exhaust.

A. Heavy-Duty Diesel Vehicles Operated by Public Agencies and Utilities

California municipal or public fleets include all federal, state, county and city government fleets plus universities and special districts such as water, utility and irrigation districts. Airports, school districts and ports also are considered to be public fleets. In 2002, ARB contracted for a survey of public agencies to be used to develop an inventory of heavy-duty public fleet vehicles (TIAX LLC 2003). ARB staff followed up on the contractor's work and surveyed additional fleets not captured by the contractor. These include vehicles owned or operated by shareholder-owned utilities that provide natural gas, water or electricity services.

Most public agencies have fleets of fewer than 15 vehicles (80.7%); 16.7 percent have 15 to 99 vehicles, and 2.6 percent have 100 or more vehicles (Table 1). Although the majority of fleets have fewer than five vehicles, they account for less than 7% of the 23,227[1] diesel fueled vehicles with over 14,000 gross vehicle weight rating (GVWR) owned by state and local agencies. On the other hand, only 2.6% of the fleets surveyed owned over 100 vehicles, but these fleets account for 46% of the vehicles owned by state and local agencies (Table 1).

[1] Vehicle Numbers estimated by 2003 Department of Motor Vehicles (DMV) registered exempt license plates.

Table 1. Public Agency Fleet Distribution

Fleet Size	Number of Fleets	Percent (%) of Fleets	Total # of Vehicles (%)
0-4	324	56.5	6.9
5-14	139	24.2	12.7
15-49	81	14.1	23.6
50-99	15	2.6	10.7
100-999	15	2.6	46.0
Total	**574**	**100**	**100**

The picture for private utilities includes many small investor-owned water companies with one or two heavy-duty diesel-fueled vehicles each (90% of the utilities), about 15 to 20 medium-sized utilities with 40 to 50 vehicles each (8% of the utilities) and a small number of large private utilities with 500 to 1,500 vehicles each (2% of the utilities).

The TIAX report provided additional details on the types of vehicle types used by public agencies. Staff analyzed only the diesel-fueled trucks over 14,000 lbs gross vehicle weight rating (GVWR) reported by public agencies in the TIAX report. Based on this, there are ten vehicle types that comprise 71 percent of the total number of diesel trucks over 14,000 GVWR (Table 2).

Table 2. Public Agencies' Diesel-Fueled Heavy-Duty Trucks By Application

Application	Percent of Fleet
Dump Truck	22
Plow & Spreader Truck	15
Sweeper	7
Cargo Truck	7
Tractor Truck	5
Sewer Truck	4
Service Truck	3
Flatbed Truck	3
Aerial Lift Truck	3
Crane Truck	2
Total:	71

Private utilities have more highly specialized vehicles when compared to public agencies. The three most common applications are specifically designed for working on and stringing power lines (Table 3) and comprise nearly half the total number of vehicles. For utilities, the top ten vehicle types account for 81 percent of the diesel-fueled vehicle types.

Table 3. Private Utilities' Diesel-Fueled Heavy-Duty Trucks Top Ten Vehicles by Application Type

Application	Percent of Fleet
Aerial Lift Truck	23
Bucket Truck	14
Line Truck	11
Material Handling Truck	9
Dump Truck	6
Flatbed Truck	5
Mechanic Truck	5
Pickup Truck	3
Welding Truck	3
Flatbed with Crane	2
Total:	81

Engine model year is particularly important for developing the emission inventory and analyzing the applicability of different technologies for reducing emissions. Staff also analyzed the diesel-fueled vehicles by engine type and model year. For the combined public agency and private utility fleet, half of the engines, as of 2004, were in the 1994 to 2006 MY engine group (Table 4). These engines were certified at 0.1 gram per brakehorsepower-hour (g/bhp-hr) PM. Staff estimates that an additional 4% of new vehicles will be added when the regulation begins.

Table 4. Public and Utility Heavy-Duty Diesel-Fueled Vehicles by Model Year Group in 2004

Engine Model Year	PM Certification (g/bhp-hr)	No. of Vehicles	Percent
1960-1987	--	6,165	21
1988-1990	0.60	3,225	11
1991-1993	0.25	3,988	13
1994-2006	0.10	16,491	55
Total		29,869	100

The predominant engines by manufacturer are International, Cummins, and Caterpillar for these medium and heavy heavy-duty diesel vehicles (Table 5).

Table 5. Public Agencies' Engine Manufacturers

Engine Manufacturer	Distribution
International	36.8%
Cummins	16.9%
Caterpillar	16.5%
Not Listed	10.9%
Ford	5.9%
Detroit Diesel	5.5%
GMC	3.8%
Navistar	1.7%
Other	2.0%
Total	99.9%

B. Regulatory Authority

The Federal Clean Air Act (CCA) grants California the authority to control emissions from mobile sources. The California Clean Air Act (Health & Safety Code (H&SC) sections 39002, 43013, and 43018) establishes the ARB as the state agency that sets standards for mobile sources. Most important to this regulation, the California Legislature also granted ARB the authority to identify toxic air contaminants and establish airborne toxic control measures to reduce risk.

1. Control of Toxic Air Contaminants

In 1983, the California Legislature adopted Assembly Bill (AB) 1807 to enact a program to identify the health effects of toxic air contaminants and reduce exposure to these contaminants in order to protect public health (H&SC sections 39650 - 39674). The Legislature established a two-step process to address the potential health effects once a toxic air contaminant is identified: the first step is the risk assessment or identification phase while the second is the risk management or emission reduction phase.

The Board is directed to address specific issues pursuant to the need for regulation (H&SC section 39665). These requirements were addressed in detail in the Diesel Risk Reduction Plan (DRRP), including the extent of present and anticipated future emissions, the estimated levels of human exposure, and the risks associated with those levels. The DRRP (ARB 2000b) describes the physical and chemical characteristics of diesel PM and the contribution to emissions by present sources, as well as the costs, availability, technological feasibility of control measures, and the potential adverse health or environmental impacts. Each of these issues is considered in the development of diesel PM regulations and will be discussed in this report specifically as each relates to this control measure.

2. Other Authority that Provides for Exemptions

Although they are owned and operated by public agencies, emergency vehicles and military tactical support vehicles are exempt from this rulemaking under other statutes and rules.

The smoke inspection program which operates pursuant to H&SC section 43701 does not make a specific reference to "motor vehicle pollution control devices." That section authorizes the adoption of standards, but does not mandate that those standards must be achieved by use of a "device." Thus emergency vehicles are subject to the requirements designed to reduce visible smoke emissions.

With regards to military tactical support equipment, the federal exemption for military tactical vehicles is stated in 40 Code of Federal Regulations (CFR) part 85, section 1703, which refines the definition of "motor vehicle" stated in section 216(2) (42 USCA 7550(2))of the CAA. California recognizes the federal military tactical vehicle exemption in section 1905 of title 13 CCR.

3. Related California Statewide Regulations

California has adopted regulations to ensure compliance with smoke emissions standards. California's Heavy Duty Vehicle Inspection and Periodic Smoke Inspection Programs require that owners eliminate excessive smoke emissions and prohibit exhaust system tampering on diesel-fueled vehicles over 6,000 lbs GVWR; the rules apply to all trucks traveling within California. These regulations impose limits on the opacity of smoke from diesel engines when measured in accordance with a snap-acceleration test procedure and have been in effect since 1991, with amendments adopted in 1997.

In February 2000, the Board adopted a new fleet rule for transit agencies and more stringent emission standards for new urban bus engines and vehicles (ARB 1999, ARB 2000c). The transit bus rule was designed to reduce NOx and PM by setting fleet emission reduction requirements, requirements for zero-emission bus (ZEB) demonstrations and acquisition and new more stringent mid- and long-term new bus purchasing standards.

In September 2003, the Board adopted regulations for in-use solid waste collection vehicles. This rule requires best available control technology (BACT) on all diesel collection vehicles over 14,000 lbs GVWR. From 2004 through 2020, staff estimates that this rule will result in the elimination of over 2.26 million lbs of diesel PM from the air. Similar rules have been adopted for stationary engines, transportation refrigeration units, and portable equipment.

The Board has also adopted limits on idling of diesel engines. In general, buses and commercial vehicles may idle no longer than 5 minutes. More stringent restrictions apply to vehicles idling near a school.

4. Related Local Regulations

The South Coast Air Quality Management District (SCAQMD) has adopted several fleet rules that apply to diesel vehicles. These rules generally require the affected public or private operator of fleets with more than fifteen vehicles to procure only alternative-fuel engines when purchasing new vehicles. In the case of school buses, the requirement is tied to the availability of grants.

- Rule 1186.1 – Less Pollution Street Sweepers
- Rule 1192 – Clean On-Road Transit Buses
- Rule 1193 – Clean On-Road Residential and Commercial Refuse Collection Vehicles
- Rule 1195 – Clean On-road School Buses
- Rule 1196 – Clean On-Road Heavy-Duty Public Fleet Vehicles

Some local air districts have enacted ordinances to encourage use of low-emission vehicles and retrofitting of existing vehicles. The Sacramento AQMD established the "Model Green Contracting Ordinance" and the "Model Low-Emission Vehicle and Fleet Ordinance" in October 2002, aimed at reducing ozone precursors in the Sacramento region. These ordinances encourage contractors to operate low-emission vehicles and amended local codes that regulate procuring and retrofitting of vehicles for public agency fleets.

The Sacramento Area Council of Government's (SACOG) Board of Directors approved a strategic plan to implement a $70 million incentive program to help clean up the region's air. This program is known as the Sacramento Emergency Clean Air and Transportation (SECAT). SECAT will provide funds to vehicle owners to replace old engines with newer engines, use clean diesel formulations such as emulsified diesel, and retrofit in-use diesel engines with after-treatment.

The San Joaquin Valley Air Pollution Control District has established a heavy-duty engine program, which provides incentive funds for the differential cost, associated with reduced emission technology as compared with the cost of conventional technology. Eligible funding categories include various heavy-duty on- and off-road vehicles and engines.

5. California Voluntary and Incentive Programs

Voluntary efforts play a key role in helping to achieve air quality goals. Incentives or early implementation credits can induce vehicle owners to reduce vehicle emissions prior to compliance deadlines or in excess of regulatory requirements. Several incentive programs exist in California which have reduced diesel PM emissions over the last several years.

The California Legislature established the Carl Moyer Memorial Air Quality Standards Attainment Program (Moyer Program) in 1998 to reduce NOx emissions from existing

vehicles. The Moyer Program funds the incremental cost of repower, retrofit, or purchase of new, cleaner engines that meet a specified cost-effectiveness level for NOx reduction. Recently, the Moyer Program has been expanded to include agricultural sources of air pollution as well as cars and light-duty trucks. Programs that may also be funded reduce hydrocarbon (HC) and PM pollution. The total Moyer Program is funded at approximately $140 million per year for the next 10 years.

In 2000, the Legislature approved new funds to reduce emissions from school buses. The goal of this incentive program is to reduce the exposure of school children to both cancer-causing and smog-forming compounds. This program utilizes two strategies to attain these goals: pre-1987 model year school bus replacement and in-use controls for later model year diesel-fueled school buses. Funding for fiscal year 2005 to 2006 is $25 million.

6. Federal Programs

The U.S. EPA established a Voluntary Diesel Retrofit Program in 2000 to address pollution from diesel construction equipment and heavy-duty on-highway vehicles. This program verifies technology that reduces emissions and allows fleet operators to choose appropriate, U.S. EPA-verified technologies that will reduce the emissions of the vehicles and engines in their fleets. U.S. EPA has also identified potential funding sources to assist air quality planners and fleet operators as they create and implement retrofit programs. The program assists air quality planners in determining the number of State Implementation Plan credits produced by their retrofit projects. The U.S. EPA has also established a program to fund school bus retrofits and replacements from penalty revenues.

The Energy Bill authorizes up to $8.5 billion for federal Congestion Mitigation and Air Quality (CMAQ) programs and expresses a strong preference for funding diesel retrofit projects. In June 2005, the U.S. Senate passed an amendment to the Energy Bill called the Diesel Emissions Reduction Act (DERA) of 2005 that provides funding to cut emissions from high-polluting diesel engines. DERA would create a national program to fund the cleanup of all types of diesel-powered vehicles, including trucks, buses, tractors, ships, and trains. The legislation authorizes $200 million per year over five years in grants and loans for states and organizations to clean up existing diesel fleets.

II. PUBLIC OUTREACH

The ARB is committed to ensuring that all California communities have clean, healthful air by addressing not only the regional smog that hangs over our cities but also the nearby toxic pollution that is generated within our communities. The ARB works to ensure that all individuals in California, especially the children and elderly, can live, work and play in a healthful environment that is free from harmful exposure to air pollution.

A. Environmental Justice

The ARB is committed to integrating environmental justice in all its activities. On December 13, 2001 (ARB 2001), the Board approved Environmental Justice Policies and Actions,[2] which formally established a framework for incorporating environmental justice into the ARB's programs, consistent with the directives of State law. Environmental justice is defined as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. These policies apply to all communities in California, but recognize that environmental justice issues have been raised more in the context of low-income and minority communities.

To achieve this ambitious goal, the ARB has established a Community Health Program and placed new emphasis on community health issues in our existing programs. The Neighborhood Assessment Program is a key component in the Community Health Program. The Neighborhood Assessment Program Work Plan presents a plan that the ARB staff proposes to use to develop guidelines for evaluating and reducing air pollution impacts at the neighborhood-scale (ARB 2000a).

The Environmental Justice Policies intends to promote the fair treatment of all Californians and cover the full spectrum of ARB activities. Underlying these Policies is a recognition that we need to engage community members in a meaningful way as we carry out our activities. People should have the best possible information about the air they breathe and what is being done to reduce unhealthful air pollution in their communities. The ARB recognizes its obligation to work closely with all stakeholders; communities, environmental and public health organizations, industry, business owners, other agencies, and all other interested parties to successfully implement these Policies.

This control measure is in direct response to the environmental justice policy to reduce health risks from toxic air pollutants in all communities, especially low-income and minority communities. This control measure, when adopted, will provide immediate air-quality benefits by reducing diesel PM emissions from public and utility vehicles which operate in neighborhoods. The actions we have taken in applying these policies in our rulemaking reflect the Board's commitment to the fair treatment of all people throughout California.

B. Outreach Efforts

As part of the environmental justice policy to strengthen our outreach and education efforts in all communities, staff held seven public workshops, and many focused meetings in the development of this rule from April 2003 to August 2005. The workshops were held at times and locations that encouraged public participation. Attendees included representatives from local, state, and federal public agencies, utilities, environmental organizations, engine manufacturers, diesel emission control

[2] Complete information for these programs can be found at http://www.arb.ca.gov/ch/ej.htm.

manufacturers, and other interested parties. These individuals participated both by providing data, reviewing draft regulations and by participating in open forum workshops, in which staff directly addressed their concerns. In addition to this, ARB staff participated in a Diesel Emission Reduction for Public Agency and Utility Fleets Technical Conference sponsored by the California Air Pollution Control Officers Association (CAPCOA) in Sacramento on August 15-16, 2005. This conference was attended by over 500 individuals representing municipal and utility fleet managers, aftreatment device manufacturers, installers, engine manufacturers, fuel producers and environmental groups.

Staff met with a number of stakeholders' groups throughout the rulemaking process. Representatives from various public agencies and private utilities assisted ARB in gathering data about their fleets and provided input in developing our data survey forms. Alternatives were suggested to the proposed regulation and explored by staff. Staff met several times with representatives of the Regional Council of Rural Counties (RCRC) and presented at a RCRC board meeting on August 11, 2004, to specifically discuss compliance issues unique to small population counties and what special provisions could be provided in the rule.

Workshops were in held in Sacramento and El Monte. The Sacramento workshops were broadcast over the internet (webcast), to provide opportunity for stakeholders throughout California to participate (Table 6). Over 3,000 individuals and companies were notified through a series of mailings. In addition, notices were posted to the web site and e-mailed to subscribers of ARB's electronic list server.

Table 6. Workshop Locations and Times

Date	Location	Time
April 3, 2003	El Monte	2:30 – 4:30 PM
December 2, 2003	El Monte	10:00 – 12:00 PM
December 3, 2003*	Sacramento	10:00 – 12:00 PM
May 17, 2004*	Sacramento	10:00 – 12:00 PM
May 18, 2004	El Monte	10:00 – 12:00 PM
October 7, 2004	El Monte	10:00 – 12:00 PM
October 8, 2004*	Sacramento	10:00 – 12:00 PM

*Webcasted workshops

To generate additional public participation and to enhance the information flow between ARB and interested persons, staff made all documents, including workshop presentations, available via the ARB's web site.[3] The web site provides background information on diesel PM, including fact sheets, workshop dates and locations, and other diesel related information and serves as a portal to other web sites with related information.

[3] Located at http://www.arb.ca.gov/msprog/publicfleets/publicfleets.htm.

III. NEED FOR REDUCTION OF EMISSION REDUCTIONS

A. Particulate Matter

PM emissions result primarily from incomplete combustion of fuel in the cylinder and lubrication oil that has entered the cylinder incidentally. Secondarily produced diesel PM is formed as a result of atmospheric reactions with diesel NOx emissions. The majority of diesel PM, approximately 98 percent, is smaller than ten microns in diameter. Diesel PM is a mixture of materials containing over 450 different components, including vapors and fine particles coated with organic substances. More than 40 chemicals in diesel exhaust are considered TACs by the State of California.

Diesel PM has been linked to a wide range of serious health problems. Particles that are deposited deep in the lungs can result in lung cancer, increased hospital admissions; increased respiratory symptoms and disease; decreased lung function, particularly in children and individuals with asthma; alterations in lung tissue and respiratory tract defense mechanisms; and premature death. Increased PM exposure causes increased cardiopulmonary mortality risk as demonstrated in a validity and causality analysis of 57 epidemiological studies. (Dab, et al. 2001). Significant positive associations exist between lung cancer incidence and the number of days per year that respirable particulates (PM_{10}) exceeded several thresholds (Beeson, et al. 1998). Long-term ambient concentrations of PM_{10} are associated with increased risks of all natural-cause mortality in males, mortality with any mention of nonmalignant respiratory causes in both sexes, and lung cancer mortality in males (Abbey, et al., 1999; McDonnell, et al., 2000).

B. Ozone

Ground-level ozone is created by the photochemical reaction between NOx and reactive organic gases (ROG). Breathing ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, shortness of breath, and congestion. It can worsen bronchitis, emphysema, and asthma. Ozone can also reduce lung function and inflame the linings of the lungs. Repeated exposure may permanently scar lung tissue. The elderly, children, and people with compromised respiratory systems are among those persons who may be most affected by exposure to ozone.

Ground-level ozone also damages vegetation and ecosystems. It leads to reduced agricultural crop and commercial forest yields, reduced growth and survivability of tree seedlings, and increased susceptibility to diseases, pests, and other stresses such as harsh weather. Ground-level ozone also damages the foliage of trees and other plants, affecting the landscape of cities, parks and forests, and recreational areas.

NOx is considered an important outdoor pollutant not only because it is an essential precursor in the formation of ground-level ozone, but also because it contributes to the formation of atmospheric acids and secondary particles. In addition, nitrogen dioxide is

a reactive gas capable of damaging the cells lining the respiratory tract. The ARB staff is currently reviewing the NO2 standard for possible revision.

IV. ENGINE AND EMISSION INVENTORY

An improved engine and emission inventory was developed for this rule's proposal, including a survey of vehicles used in California's public fleets. The ARB contracted with TIAX LLC (formerly Arthur D. Little) to survey California public fleets to allow staff to develop a comprehensive understanding of vehicles and equipment used by various public agencies (TIAX LLC 2003). The survey started in February 2002 and was completed in February 2003. The final database contained data for 178 fleets representing 57 percent of the DMV estimated heavy-duty vehicles over 8,500 GVWR and equipment owned and operated by public agencies. The report also conveyed data on engine make, model, model year, vehicle types, as well as activity characteristics of vehicles (i.e., mileage and fuel consumption) used in public fleets in California.

Federal agencies, some large public agencies and all private, shareholder-owned utilities were not included in the TIAX study, so staff continued the survey in 2004. In addition to the public agencies, staff contacted the three largest investor-owned private utilities[4] to request vehicle information. All responded with some information about their fleets. Two of the utilities provided detailed information on their vehicles such as engine make, model, model year, vehicle type and current odometer. In addition, staff surveyed smaller utilities and contacted them by telephone for information on their vehicles.

A. Engine Inventory

Staff estimates the population of diesel vehicles over 14,000 GVWR owned by state and local agencies is 23,227 based on analysis of the 2003 Department of Motor Vehicles (DMV) database for exempt vehicle license plates[5]. We gathered engine and fleet data for approximately 57 percent of the vehicles used by these public fleets and 79 percent of the vehicles used by utilities. Staff extrapolated these data to obtain a picture of the entire fleet of California's public and utility owned on-road diesel vehicles. The population is expected to remain relatively stable or increase slowly during the implementation of this regulation because of budgetary constraints. Public agencies tend to keep a vehicle in service for over ten years on average and thus fleet turnover (the time a vehicle is retired from service) is expected to remain relatively slow.

Staff estimates there are 3,979 heavy-duty vehicles (as of 2004) owned or operated by private utilities subject to this rule. Approximately 3,130 of these are owned or operated by the three largest investor-owned utilities: Southern California Edison, PG&E, and Sempra Energy (Southern California Gas Company and San Diego Gas & Electric). In

[4] Pacific Gas and Electric, Sempra Energy (Southern California Gas, San Diego Gas and Electric), Southern California Edison

[5] This number excludes emergency vehicles, school buses, solid waste collection vehicles and transit buses.

addition, staff identified about twenty additional utilities with 664 heavy-duty vehicles that are listed in the ARB's Periodic Smoke Inspection Program (PSIP) database. Staff identified about 185 small water companies from the California Public Utilities Commission (CPUC) lists. Telephone contact with these small water companies determined that, on average, each has about one vehicle per company that may be impacted by this regulation. For federal fleets, the United States Postal Service (USPS), several military bases, and the federal General Service Administration (GSA) also submitted survey information on their heavy duty diesel vehicles accounting for approximately 2,663 vehicles subject to the rule.

Combining these data, staff estimated the 2004 population of public agency and private utility vehicles covered by this proposal to be 29,869.

B. Emission Inventory

The California on-road vehicle emission inventory data consists of two elements: engine emissions and vehicle activity. The emissions-related data reflect new vehicle testing information and the latest vehicle registration data from the DMV. The activity-related data are updated by the regional transportation agencies that estimate the daily vehicle miles of travel, the distribution of travel by speed, and the number of starts per vehicle per day by year. In addition, staff conducted a temperature exhaust study to determine the percentage of vehicles that would be amenable to passive diesel emission control systems. A summary of this study is provided in Section VI.E. The on-road emission inventory is then derived using a mathematical model developed by ARB named EMission FACtor (or EMFAC).

Staff calculated the emission inventory for public agency and private utility vehicles using the EMFAC model. Certain parameters such as vehicle age distribution, population and turn over (useful life) were updated based on the surveys staff did to support this regulatory purpose and incorporated into the revised inventory (Appendix B). Gasoline vehicles, alternative fueled and vehicles less than 14,001 lbs GVWR were not included in the emissions analysis.

The baseline emissions for pubic agency and private utility vehicles (Table 7) gradually decline over time naturally with the introduction of cleaner engines in the 2007 and 2010 model years.

Table 7. Baseline Public Agency and Private Utility Inventory (Tons Per Year)

Calendar Year	PM	NO_x	HC	CO
2000	165	4061	365	895
2005	140	4148	103	837
2010	93	3680	84	730
2015	63	3093	72	644
2020	45	2676	59	600

V. SUMMARY OF PROPOSED CONTROL MEASURE

Staff recommends that the Board adopt new sections 2022 and 2022.1, as set forth in Appendix A. The core of this proposal is a requirement that each municipality and private utility apply best available control technology (BACT) to its on-road heavy-duty diesel vehicles to reduce diesel PM emissions and associated health impacts according to the rule's schedule. The proposed rule is based on the proposed control measure listed in the Diesel Risk Reduction Plan (ARB 2000).

A. Scope and Applicability

The proposed rule applies to municipalities and private utilities that own or operate one or more diesel-fueled on-road vehicles with a GVWR greater than 14,000 lbs, powered by a heavy-heavy or medium-heavy duty 1960 to 2006 MY engines. Medium and heavy heavy-duty diesel trucks have the highest diesel PM emissions when compared to all medium duty/light heavy-duty trucks and thus focusing on these vehicles is a cost-effective mechanism for diesel PM reduction, as will be discussed later. The regulation does not apply to emergency vehicles described in the California Vehicle Code 27156.2 or military tactical vehicles which in general are exempt from certain air pollution control requirements. It also does not include solid waste collection vehicles, school buses, transit buses or off-road vehicles which are subject to separate state regulations or programs. Gasoline vehicles are excluded if they do not meet the standards specified in these regulations.

A municipality is defined in section 2020, title 13 of the California Code of Regulations (CCR) as a city, county, city and county, special district, or a public agency of the United States of America or the State of California, and any department, division, public corporation, or public agency of this State or of the United States, or two or more entities acting jointly, or the duly constituted body of an Indian reservation or rancheria. A utility is a new definition proposed by the regulation and is defined as a privately-owned company that provides the same or similar services for water, natural gas, and electricity as a utility operated by a municipality.

B. Best Available Control Technology (BACT)

The proposed rule requires that a municipality or utility reduce diesel PM emissions through application of BACT by the applicable implementation dates.

BACT is defined in this section as one of four compliance options:

(1) Use of a engine or power system certified to the 0.01 g/bhp-hr particulate emission standard; or

(2) Use of an engine or power system certified to the 0.1 g/bhp-hr particulate emission standard, in conjunction with the highest level verified diesel emission control strategy (DECS); or

(3) Use of an alternative-fuel, heavy-duty pilot-ignition, or gasoline engine; or

(4) Use of an existing engine used in conjunction with the highest level verified DECS.

A public agency or utility that chooses to repower a vehicle with an engine certified to the 0.01 g/bhp-hr PM standard (option 1), would use an engine certified to either the optional 0.01 g/bhp-hr particulate emission standard as specified in title 13, CCR, section 1956.8(a)(2), or the 0.01 g/bhp-hr particulate emission standard as specified in title 13, CCR, section 1956.8(a), when it becomes effective in 2007. This option has a greater cost, as it entails either purchasing a replacement vehicle or engine (also called engine repowering), but may be preferred by a public agency or utility when the vehicle being replaced is nearing the end of its useful life. Engines certified to 0.01 g/bhp-hr PM, however, will not be generally available for vehicles until the 2007 MY.

A public agency or utility that chooses to repower a vehicle with an engine certified to a 0.1 g/bhp-hr particulate emission standard (option 2) as specified in title 13, CCR section 1956.8, must also install the highest level DECS that is verified in accordance with 13 CCR section 2702(f). The DECS must be the highest level that the retrofit manufacturer or authorized dealer agrees that can be used on that engine.

No additional controls are required to reduce diesel PM emissions from alternative-fueled or gasoline vehicles (option 3) because, by definition, alternative-fuel or gasoline vehicles do not emit diesel PM. Staff wanted to ensure that only the cleanest alternative fueled or gasoline engines would be considered BACT, therefore for MY 2004-2006 alternative fueled engines must be certified to the optional reduced emission standards specified in title 13 CCR section 1956.8(a)(2)(A). Similarly, in order for gasoline engines to be considered BACT, they must be certified to the 2005 model year and later emission standards for heavy-duty Otto cycle engines specified in title 13 CCR section 1956.8(c)(1)(B) and 1976(b)(1)(F). Beginning in 2007, both alternative fuel and gasoline engines will be required to meet the stringent standards set for diesel fueled engines. A certified dual-fuel engine, however, uses both diesel fuel and an alternative-fuel, and is not considered to meet BACT because of the relatively high proportion of

diesel fuel used. Thus an owner with a dual-fuel vehicle must still comply with the rule, for example by installation of a verified diesel particulate filter. A heavy-duty pilot-ignition engine is treated like an alternative-fuel engine in this rule because of its relatively low proportion of diesel fuel compared to alternative-fuel usage. This engine would use diesel fuel in less than ten percent of its duty cycle for engine ignition and cannot operate or idle solely on diesel fuel at any time. It should be noted at this time no such engine is currently certified in California.

The last option (4 above) is to install a verified DECS to meet the BACT requirement. This is the least expensive option. If a municipality or utility plans to comply using this option, the technology must be verified by ARB. Several DECSs have received approval under the Verification Procedure for In-Use Strategies to Control Emissions from Diesel Engines (title 13, CCR, sections 2700-2710).

Under this procedure, diesel PM control devices can be verified to one of three levels: Level 1, greater than 25 diesel PM reduction; Level 2, greater than 50 percent; and Level 3, 85 percent and greater diesel PM reduction. BACT is determined by Level, not by percent emission reduction. Thus a technology that reduces diesel PM by, for example, 45 percent is equivalent, under this rule, to one that reduces diesel PM by 25 percent. Both get the same credit in this rule as Level 1 DECS. Table 8 shows the PM emission levels which result when the three levels of verified devices are applied to various engine model years. A DECS can also be optionally verified to reduce NOx emissions by a minimum of 15 percent reduction. ARB has verified a few DECS that are verified to reduced PM and NOx emissions.

Table 8. Potential Reductions from the Use of DECSs.

Engine MYs	New Engine Particulate Standard (g/bhp-hr)	PM Emissions (g/bhp-hr)		
		Level 3	Level 2	Level 1
1960 – 1987	None	85% reduction	50% reduction	25% reduction
1988 – 1990	0.6	0.09	0.30	0.45
1991 – 1993	0.25	0.04	0.13	0.19
1994 – 2006	0.1	0.02	0.05	0.08
2007+	0.01	NA	NA	NA

In this rule, BACT is evaluated on a vehicle-by-vehicle basis. A municipality or utility must evaluate the highest level DECS that can be installed and operated successfully for each combination of an engine and vehicle. If a Level 3 DECS is available for the engine, this option must be applied to the engine provided the DECS manufacturer or authorized dealer agrees that the DECS will work in that vehicle. A municipality or utility is required to investigate the highest level DECS appropriateness to a particular vehicle, prior to installation of a lower level DECS. If a Level 3 is not available or feasible, then a

Level 2 option must be explored. A device verified to this level, for example, might be employed for those vehicles that do not have the appropriate PM to NOx ratio or exhaust temperature for a Level 3 DECS such as a passive diesel particulate filter.

A Level 1 DECS is acceptable only if it is the only option available for the engine or application. It should be noted that the regulation does not allow 1960 to 1987 MY engines (Group 1) to use Level 1 technology, unless the municipality or utility is located in a county meeting the "low-population" definition. If no DECS is verified and feasible, the municipality or utility may apply for an implementation delay, as discussed later, but will eventually have to repower or otherwise replace the engine with one meeting the 0.01 g/bhp-hr PM standard, an alternative fuel engine, a heavy-duty pilot ignition, or gasoline engine. Technologies to meet the BACT option are discussed in more detail in Section VI.

The general approach of applying BACT is consistent with the solid waste collection vehicle rule previously adopted by the Board.

C. Implementation Schedule

Staff proposes two different implementation schedules. The first is for all municipalities or utilities (Table 9). The second is an optional schedule that a municipality or utility, located in a specified low population county may elect to follow (Table 11). The purpose of the optional schedule is to reduce costs by lengthening the compliance period.

1. General Schedule

Table 9. Implementation Schedule for 1960 to 2006 MY Engines

Group	Engine MY	Percentage of Group to Use Best Available Control Technology	Compliance Deadline
1[a]	1960 – 1987	20	December 31, 2007
		60	December 31, 2009
		100	December 31, 2011
2	1988 – 2002	20	December 31, 2006
		60	December 31, 2008
		100	December 31, 2010
3	2003 – 2006	50	December 31, 2009
		100	December 31, 2010

[a]Group 1: A municipality or utility not use Level 1 technology as BACT

Currently, the higher emitting, mechanically controlled, MY 1960 to 1987 engines (Group 1), are more difficult to retrofit. The best option to reduce PM emissions from these vehicles may be to purchase a new vehicle with a 2007 MY engine. Although replacement with a new 2007 MY vehicle is not required by this rule, staff has adjusted

the starting implementation date for this group to December 31, 2007, to allow owners to take advantage of these engines. This compliance mechanism would produce the largest overall reductions in diesel PM emissions.

A municipality or utility could also replace a 1960 to 1987 MY engine with a newer mechanically controlled engine (i.e., MY 1991-1993), and then retrofit this engine with the highest level verified DECS. This would result in the engine moving from the Group 1 to the Group 2 in the compliance schedule.

Group 2, or 1988 through 2002 MY engines, begin implementation in December 31, 2006, one year earlier than the Group 1 engines. ARB has verified Level 3, Level 2 and Level 1 DECS for all MY engines in this group, thus an earlier compliance deadline is justified.

Vehicles with 2003 to 2006 MY engines (Group 3) are to be brought into compliance by the end of 2010. This group currently comprises the smallest portion of the fleet (four percent) and exhaust gas recirculation (EGR) is widely used on these engines to control NOx emissions. Currently there is one Level 3 passive DPF verified for use with an engine that employs exhaust gas recirculation (EGR). However, there are several level 1 and one level 2 currently verified DECS for this MY group.

2. Municipality or Utility Located in a Low Population County

Staff recognizes that a municipality located in a low population county may have less access to revenue sources such as vehicle license fees, road tax, property taxes, sales taxes, etc. than those located in other areas in the state and utilities have fewer customers. Therefore, staff proposes a special, optional implementation schedule for public agencies and utilities located in counties with populations below 125,000 as of July 1, 2005, based upon 2001 population projections by the California Department of Finance. These counties are considered “low population” and are listed in Table 10. Figure 1 shows a map where these counties are located with the overlay of the California air districts in bold.

Table 10. Low Population Counties: Populations Under 125,000

COUNTY	Projected Population as of July 2005
ALPINE	1,300
SIERRA	3,700
MODOC	10,100
TRINITY	13,800
MONO	14,200
INYO	18,800
MARIPOSA	19,600
PLUMAS	21,900
COLUSA	24,200
DEL NORTE	31,500
GLENN	31,800
AMADOR	37,600
LASSEN	39,800
SISKIYOU	47,200
CALAVERAS	47,800
TUOLUMNE	62,200
TEHAMA	63,400
SAN BENITO	63,600
YUBA	66,000
LAKE	69,200
SUTTER	90,400
MEDOCINO	95,500
NEVADA	106,300

[1]Reference: State of California, Department of Finance, *Interim County Population Projections*.Sacramento, California, June 2001

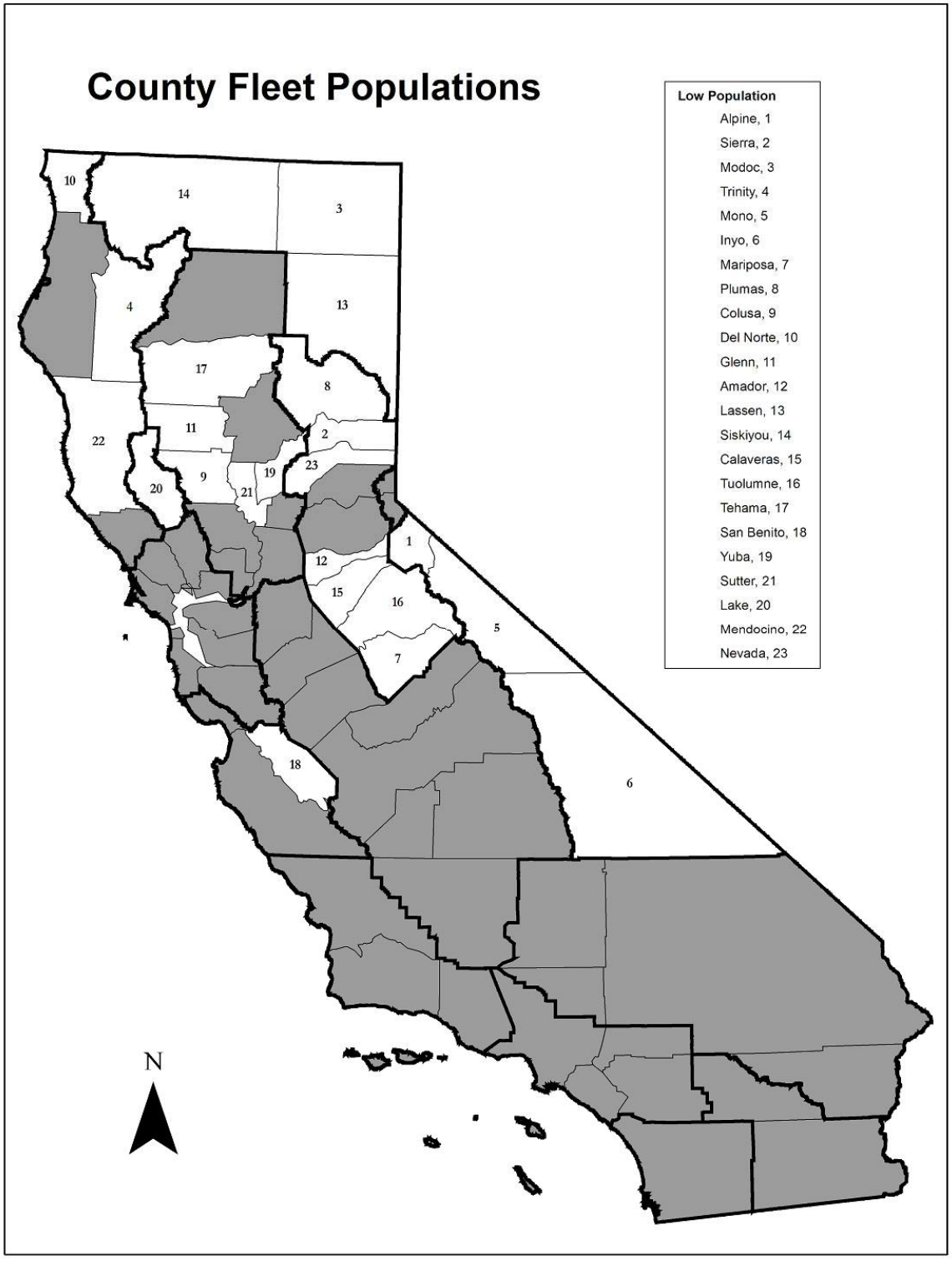

Figure 1. Map Showing Locations of Low Population Counties

These municipalities or utilities may follow the alternate compliance schedule provided below (Table 11):

Table 11. Implementation Schedule for a Municipality or Utility Located in a Low-Population County

Group	Engine Model Years	Percentage of Group to Use Best Available Control Technology	Compliance Deadline, as of December 31st
1	1960 – 1987	20	2009
		40	2011
		60	2013
		80	2015
		100	2017
2	1988 – 2002	20	2008
		40	2010
		60	2012
		80	2014
		100	2016
3	2003 – 2006 (Includes dual-fuel and bi-fuel engines)	20	2011
		40	2012
		60	2013
		80	2014
		100	2015

At the request of Regional Council of Rural Counties[6], staff also included a special provision that allows the use of Level 1 DECS on 1960 to 1987 (Group 1) engines for municipalities or utilities located in low population counties.

3. Municipalities or Utilities Located in a Low Population County Accelerated Turnover Option

Many municipalities located in low population counties stated they still would be unable to comply with the rule even with the extended implementation schedule. Therefore, based on this input from low population counties, Regional Council of Rural Counties and several Air Pollution Control Districts, staff developed the accelerated turnover option.

This option requires that a municipality or utility located in a low population county commit to retiring all their 1993 and older engines by December 31, 2020. An owner could elect to retire the vehicle or repower the vehicle with a 1994 or newer engine to comply. This option also requires that the owner apply BACT to their total fleet by December 31, 2025. The municipality or utility must notify the ARB by July 31, 2008, if

[6] Regional Council of Rural Counties letter to ARB dated November 9, 2004, September 9, 2004, and September 7, 2005.

this compliance option is selected. The municipality or utility would still be required to comply with all other requirements of the rule such as record keeping.

D. Calculating Fleet Size for Implementation

The total number of vehicles comprising a fleet may vary from year to year because of new purchases and retirement of older vehicles, thus complicating the calculation of the number of vehicles that must be in compliance each year. Staff has therefore developed formulas to specify how an owner must calculate the number of vehicles to be brought into compliance each year.

To determine compliance during the phase-in, the municipality or utility needs to calculate its fleet size January 1st of each year where a compliance deadline is applicable. For example, the first compliance date is January 1, 2006. The following equations are used to calculate fleet size for any given year.

Total number (by group) of municipality or utility's fleet vehicles ($\#MUV_{by\ group}$) is equal to the total number of engines subject to the rule ($\#Engines_{by\ group}$) including gasoline or alternative fueled engines that meets the definition of BACT, plus the number of vehicles retired in the previous year ($TotRetire_{by\ group}$), beginning with January 1st of the initial applicable compliance deadline. For example, for Group 2 vehicles, only vehicles retired in the 2006 calendar year or later would be counted as retired. Note also that, under this proposed rule, "retirement" means that the engine is scrapped, sold out of state, or converted for use in a "low usage vehicle." If an engine (or vehicle) has BACT applied prior to sale, it may be counted as a retired vehicle; however an engine (or vehicle) that is simply sold within the state is not included in the calculation as a retired vehicle, but disappears from the fleet in the annual count of engines. This is shown in equation (1) below:

$$\textbf{(1)} \qquad \#MUV_{by\ group} = \#Engines_{by\ group} + TotRetire_{by\ group}$$

The total number of vehicles that must be phased in during a given year by group ($TotVeh_{by\ group}$) is calculated by taking the percentage of vehicles that must meet BACT for that particular year (Group%BACT) multiplied by the municipality's or utility's total fleet number as of January 1st of that compliance year ($\#MUFV_{by\ group}$) from equation (1). This is shown by equation (2).

$$\textbf{(2)} \qquad TotVeh_{by\ group} = Group\%BACT * (\#MUV_{by\ group})$$

After the first year of compliance, to calculate how many additional vehicles are required to meet BACT by the next compliance deadline ($TotAddComp_{by\ group}$), then the total vehicles are calculated as shown in equation (1) and (2), then the number of vehicles in already in compliance ($TotBACT_{by\ group}$) and the number of vehicles which have been removed the model year group by retirement in prior years ($TotRetire_{by\ group}$) are subtracted. Again, only engines that have been retired through scrapping, sale out of state or has had BACT applied if sold within the state can be counted as retired. All

engines retired since the initial compliance year (for example, 2006 for Group 2) may be included in ToTRetire. This is shown in equation (3).

$$\textbf{(3)} \quad \textbf{TotAddComp}_{\textbf{by group}} = \textbf{TotVeh}_{\textbf{by group}} - \textbf{TotBACT}_{\textbf{by group}} - \textbf{TotRetire}_{\textbf{by group}}$$

In the final compliance year for each group, all remaining vehicles must be brought into compliance. If the number of vehicles to be brought into compliance is not equal to a whole number (TotAddComp), the municipality or utility is expected to round to the nearest whole vehicle. A municipality should round up when the fractional part of number of additional vehicles to be brought into compliance (TotAddComp) is greater than or equal to one-half of a vehicle, and round down to the nearest vehicle when the fractional part of TotAddComp is less than one-half of a vehicle. It should be noted, gasoline vehicles that do not meet the emission standards specified for BACT are excluded from the initial total fleet number ($\#MUV_{\text{by group}}$); while gasoline engines meeting the requirements for BACT are counted in the total fleet number and are counted as a compliant vehicle for determining $TotBACT_{\text{by group}}$ in Equation 3.

Five sample fleet size calculations are given in Appendix E to illustrate various cases a municipality or utility might experience.

E. Compliance Extensions

Under a variety of conditions, owners may be justified in requesting and receiving compliance extensions. During the public workshop process, staff identified six different circumstances that would potentially justify a request for a compliance extension: early implementation, no verified DECS, fleets located in a low population county, dual-fuel or bi-fuel vehicle, engines near retirement, and participation in an experimental DECS project.

1. Early Implementation

Many public agencies and utilities have proactively taken steps to reduce emissions from their vehicles through early application of BACT. Staff proposes to give some allowance to these fleets in the following two situations.

If a municipality or utility has applied BACT to 50 percent of its vehicles in Group 1 (MY 1960 – 1987) before December 31, 2007, the owner may delay 100 percent compliance of the Group 1 vehicles to December 31, 2012. Likewise, if a municipality or utility applied BACT to 50 percent of its vehicles in Group 2 (MY 1988 – 2002) before December 31, 2006, the owner may delay 100 percent compliance of the Group 2 vehicles to December 31, 2012. A municipality or utility may count each vehicle that meets BACT, as defined in section 2022.1(b) as of January 1, 2005 as a compliant vehicle. This allows a municipality or utility that has previously converted a vehicle to alternative fuel, for example, to subtract this vehicle out of the calculation for additional vehicles required to be brought into compliance for a given calendar year.

A municipality or utility that implements early will not be required to install a higher level DECS if one becomes available between the time the DECS is installed early and the mandated compliance date. A compliance extension for early implementation allows municipalities and utilities to stretch out implementation beyond required dates while at the same time implementing early in at least half of the vehicles. In addition, municipalities and utilities may qualify for incentive funding based on early implementation because it is voluntary and occurs prior to the mandated implementation dates.

2. No Verified Diesel Emission Control Strategy

Staff proposes to allow a municipality or utility a delay in implementing BACT if no verified DECS exists for an engine and application. This delay recognizes the higher cost of an engine repower or replacement and provides the owner additional time to plan for this cost. In addition, during the time allowed for a delay, effective DECS may become verified. This extension applies only after the owner has applied DECS to every applicable engine.

Two methods of granting delays are proposed. Either the Executive Officer would grant a blanket one-year compliance extension or, if the municipality or utility may apply for a compliance extension. Staff proposes the Executive Officer grant a one-year implementation delay without requiring documentation as to the unavailability of verified technology in the event no DECS has been verified for a specific engine or application, or one is not commercially available, by ten months prior the implementation date for that group.

In the second case, a DECS could be verified for an engine, but not able to be used in a specific application. In this case, staff proposes an owner may apply no later than July 31st of the year for which he or she is requesting an extension. The owner must provide documentation that all verified DECSs have been investigated and shown not to work on a particular engine or set of engines, or for that vehicle's particular application. Evidence convincing to ARB would include, for example, a letter from a DECS manufacturer showing evidence of data collected that demonstrates the DECS will not function on that particular vehicle because of its duty cycle. Other examples of justified reasons for an owner applying for an implementation delay would be if the engine is under an original engine warranty and application of a DECS would void that warranty, or if a DECS is not commercially available. In these cases, the documentation should be provided to validate the need for a delay.

ARB has an existing procedure for responding to requests for extension as codified in title 17, CCR, section 60030. Within 90 days after the application is accepted for filing, the Executive Officer will issue his/her approval or disapproval of the compliance extension request.

Staff proposes, however, that an owner not be granted extensions indefinitely because there are other BACT options. Staff proposes that if no DECS for a specific engine or

application is available through 2012 for MY 1960 to 1987 (Group 1) engines, the owner would be required to use one of the following BACT: an engine that achieves the 0.01 g/bhp-hr PM standard, a newer 1988 to 2002 (Group 2) engine that can use a verified DECS or an alternative-fueled, heavy-duty pilot ignition or gasoline engine, by December 31, 2011. Similarly, for MY 1988 to 2002 engines, compliance extensions are not given for longer than to December 31, 2011. The municipality or utility would, therefore, be required to employ another BACT by December 31, 2012. No compliance extensions are proposed for MY 2003 to 2006 (Group 3) engines.

3. Dual Fuel or Bi-Fuel Engine

Staff proposes that a dual-fuel and bi-fuel engine of any model year implement BACT according to the 2003 to 2006 MY engine compliance schedule in recognition of its relatively lower certified NOx emissions and because many public agencies purchased these vehicles as part of programs to reduce NOx emissions. A delayed implementation schedule for these vehicles allows public agencies to plan for the additional cost of a retrofit. A public or utility fleet vehicle with a dual-fuel engine retrofitted with a verified level 3 diesel particulate filter is in compliance with the BACT requirement.

4. Engine Near Retirement

Staff proposes to allow a compliance extension for engines within one year of retirement. Retirement, as discussed earlier, refers in this regulation to sale outside of the State of California, scrappage of the engine, or conversion to use only in a low-usage vehicle[7]. If the engine is within one year of retirement as of the applicable compliance date, then staff proposes that the owner could take advantage of a one year delay for compliance. Similarly, if an installed DECS fails and it cannot be repaired, and the vehicle is within one year of retirement, the DECS would not be required to be replaced or upgraded. In the case of this compliance extension, staff envisions that the only case in which this would be used is in the final compliance year. In previous years, the owner needs to apply a DECS to all applicable engines.

5. Use of Experimental Diesel Emission Control Strategy

Many municipalities and utilities have participated in demonstrations of experimental technology designed to reduce diesel PM. This regulation requires the use of verified DECS, and by its nature an experimental technology will not have received verification. Staff, therefore, proposes a municipality or utility be allowed to install experimental technology on no more than twenty vehicles or ten percent of the fleet (whichever is less) for testing and evaluation. Each vehicle being used for the demonstration would be deemed to be in compliance with this rule for the duration of the experiment, provided the experimental technology reduces diesel PM and a valid experimental permit has been obtained from ARB. At the termination of the experiment, the

[7] A low usage vehicle is defined in the proposed regulation as a vehicle that is operated for fewer than 1000 miles or 50 hours per year, based on a five-year rolling average.

experimental technology would be removed, unless it has received appropriate verification from ARB, and replaced with the verified DECS as required, within six months of termination of the experiment. No experimental DECS may be used after December 31, 2012, to meet the BACT requirement.

These provisions provided in sections V.E.1-5 are consistent with the previously adopted rule for the Solid Waste Collection Vehicles.

6. Accelerated Turnover Option

Staff has included an Accelerated Turnover Option for municipalities or utilities located in low population counties. To participate in this option, these municipalities or utilities must notify ARB in writing by July 31, 2008. This date is six months prior to the first implementation deadline for municipalities or utilities located in low population counties.

If a fleet elects to participate in this option, they would send a letter to the ARB indicating that they would be participating in this option. The fleet would then be required to label all their trucks by December 31, 2006, as participating in the "accelerated turnover option". The fleet would not be required to do anything to their vehicles until 2020, when they would be required to retire all their vehicles with engines 1993 and older, and replace these with vehicles with engines newer than 1994. The fleet could also repower all their vehicles with 1993 engines with 1994 and newer engines to comply with this option. Then the fleet would not do anything until 2025, when they would be required to apply BACT all their vehicles.

F. Diesel Emission Control Strategy Special Circumstances

Staff has included in the proposed rule provision to address special circumstances that may arise during its implementation.

1. Fuel Strategy DECS

A municipality or utility must apply the highest level DECS available for a particular engine. There could be a situation where a fuel based strategy may be the highest level DECS for a small number of vehicles in a municipality or utility's fleet. Some fuel based DECS strategies require the fuel be stored in a dedicated tank, and for a small number of vehicles the infrastructure cost could be unreasonable. Therefore, staff has included a provision where a fleet could request the use of a lower level non fuel-based DECS on these vehicles where the highest level DECS would only be a fuel based strategy. For example, say a fleet has 100 vehicles and 90 could use a level 3 passive diesel particulate filter and 10 meet the criteria to use a level 2 diesel emulsified fuel. Use of this fuel would require installation of a dedicated fuel tank. In this case, the fleet could request to use a level 1 diesel emission control strategy for these 10 vehicles provided they are not in the oldest group of vehicles (1960 to 1987 engine MY).

Another situation could exist where a fleet decides to use a fuel based DECS across its entire fleet. However, the highest level DECS for certain vehicles within the fleet may be a Level 3 hardware device. In this case, the fleet could request to use a lower DECS on the few vehicles that are amenable to a Level 3 DECS, in order to accommodate a minimum Level 2 fuel based DECS across the entire fleet.

2. Failure or Damage of a DECS

For various reasons, a DECS might fail or be damaged during the lifetime of an engine. The intent of this regulation is to reduce diesel PM emissions for the life of an engine. Staff proposes if a DECS fails or is damaged while it is within its warranty period, the municipality or utility be allowed to repair or replace the DECS with the same or comparable DECS, as provided under the DECS manufacturer's warranty. If, however, the DECS fails or is damaged outside of its manufacturer-provided warranty, staff proposes the municipality or utility would then be required to install the highest verified level DECS available. For example, if a vehicle initially is retrofitted with a Level 1 DECS or another BACT, and a Level 2 or Level 3 DECS becomes available after the Level 1 DECS warranty expires and the DECS fails, then the municipality or utility would be required to upgrade the DECS to the higher level DECS.

3. Discontinuation of Fuel as a DECS

If a municipality or utility chooses to discontinue use of fuel verified as a DECS under section 2022.1(b) of the proposed regulation, it would be required to use another BACT. In the event another BACT is not commercially available within 30 days from the date of discontinuation of a fuel verified as a DECS, a compliance plan must be submitted to the Executive Officer no later than 30 days after discontinuation of the use of the fuel verified as a DECS. This plan must demonstrate how the municipality or utility will bring its vehicles into compliance within six months.

4. Limited Use of a Level 1 DECS

While use of a Level 1 DECS is allowed in most cases when no level 2 or 3 DECS is available, the relatively low level of PM reduction (25 percent) is a concern. Widespread use of Level 1 DECSs would not achieve the goals of 75 percent diesel PM reduction by 2010 and 85 percent diesel PM reduction by 2020. Therefore, staff proposes to allow a municipality or utility to use a Level 1 DECS for a limited time period as a BACT. The time limit for Group 2 (MY 1988 – 2002) is ten years.

A municipality or utility is not allowed to use a Level 1 DECS on MY 1960-1987 (Group 1) engines due to their extremely high PM emission rates. An owner would be required to apply at least a Level 2, Level 3 or another BACT to these engines. If no DECS is verified or available for Group 1 vehicles, then the owner would be eligible to apply for a compliance extension, after which the owner would have to repower or replace the engine as per sections 2022.1 (b)(1), or (b)(2). Alternatively, a municipality or utility could repower a vehicle with a newer engine such that it would be amenable to a

verified DECS. It should be noted that the regulation does allow Level 1 DECS to be used on 1960-1987 (Group 1) engines located in low population counties to meet BACT. However, the use of a Level 1 DECS even on these engines would be limited to ten years. This provision was provided at the request of the Regional Council of Rural Counties and several air pollution control districts. This would provide a certain level of PM reduction for the oldest trucks and allow additional time for agencies or utilities located in low population counties to procure newer vehicles that could be amenable to higher level DECS.

Staff proposes that the time limit for use of a Level 1 DECS on Group 3 (MY 2003-2006) vehicles be five years since it is anticipated there will be level 3 or 2 technologies available for most engines during the rule's implementation timeframe. Therefore, it is proposed that a fleet owner be required to upgrade a level 1 DECS after five years, since these vehicles will be in the fleet for a very long time.

G. Record Keeping Requirement

Municipalities and utilities must keep records as required by the regulation, and make those records available for inspection during enforcement audits by ARB personnel. Certain records as described by section 2022.1(f) must be kept at the terminal where the vehicle normally resides and others must be kept in the vehicle. If a municipality or utility is found to be out of compliance with this record keeping requirement, enforcement actions may be initiated.

1. Records Accessible at Terminal

Records to be kept at the facility where the vehicle normally resides (or other centralized location) include a list of the vehicles covered by the proposed regulation that identifies each vehicle by type, engine manufacturer, engine model, engine model year, series, engine family, and status as a low usage vehicle (if applicable). That information must be tied to specific DECS that are installed in each vehicle.

DECS information required includes the type of DECS, its serial number, manufacturer, model, level, and date of installation, or first date of use if a fuel DECS. The reason for choosing a Level 1 or Level 2 verified DECS must also be maintained. If a Level 3 verified DECS is available, then the DECS manufacturer or authorized dealer must provide reasoning for not using that DECS. DECS maintenance records would also need to be available. In the case of fuel or fuel additives used as a DECS, purchase records would need to be kept for the most current two years worth of purchases.

If a municipality is following the implementation schedule in for a low population county, then it must maintain documentation affirming that the vehicles are not at any time operated in a metropolitan statistical area as defined by the U.S. Census Bureau.

2. Records Kept in Vehicle

Staff also proposes that a municipality or utility be required to keep certain information in the vehicle, which can be accessed during roadside inspections. In order to have vehicle records easily accessible, ARB proposes a label with the required information be affixed to the driver's side door jam, or another location known by the driver and readily visible to an inspector.

For a vehicle with an installed DECS, the information required is the same as that required under the Verification Procedure in section 2706 (g). This includes the manufacturer's name, address, and phone number; the DECS family name; product serial number, month and year of manufacture plus the date of installation of the DECS, or date of first use if the DECS is a fuel.

Staff believes this information is needed to enforce the rule. Without this information, an inspector might have to dismantle a muffler housing, for example, to determine that a diesel particulate filter was installed. In addition, other regulations require certain records be kept in vehicles, such as manifests, therefore staff believes it is not unreasonable to require these records be kept in vehicles.

3. Requirement for Transfer of Records

The regulation requires that once a vehicle is in compliance it must remain in compliance with this regulation. Therefore, if ownership of a vehicle is transferred, the seller shall give these records to the buyer, or a third party sales representative.

H. Contractor Compliance Requirement

Staff has proposed that municipalities and utilities include compliance contract language when hiring a private company for services that a municipality or utility would normally provide. For instance, because many municipalities do street sweeping, a contract to provide this service would be subject to this condition. The compliance contract language is in section 2202.1(g) and proposes that municipalities and utilities add a statement in all contracts that a company is in compliance with all applicable air pollution control laws in order to be considered for bid. A similar provision was adopted in the solid waste collection vehicle rule where it was discovered many existing contracts already have boiler plate language similar to this one proposed. This simply provides another level of back-up that both municipalities and contractors are required to comply with all existing air pollution control regulations, local ordinances, and any future retrofit rules for private companies.

I. Non-Compliance and Enforcement

To ensure compliance with this rule, ARB staff will inspect the records and verify installation of DECS during inspections under the Periodic Smoke Inspection Program[8]. If a fleet is in non-compliance with the regulation a penalty of up to $1,000 per vehicle per day can be imposed. If further investigation determines the municipality or utility neglected or intentionally violated the regulation, penalties of up to $10,000 per vehicle per day may be imposed.

VI. TECHNOLOGICAL FEASIBILITY OF CONTROL MEASURE

Reducing emissions from diesel engines is an area of active research and development. Engine manufacturers are close to deploying engines that meet the California and federal 2007 engine standards for demonstration in fleets, and they are developing technologies to further reduce NOx emissions for the 2010 standards. The field of exhaust aftertreatment, or retrofitting engines, is growing rapidly, spurred both by the research and development ongoing to new engines and by California's diesel emission reduction regulations. Based on its evaluation of the technology available today and an assessment of technology likely to be available in the near future, staff is confident that the proposed control measure is technologically feasible. The following sections describe the availability and feasibility of various exhaust emission control technologies.

A. Availability of Ultra-low Sulfur Diesel Fuel

Many diesel emission control technologies are adversely affected by sulfur in the fuel. Ultra-low sulfur (15 ppmw or less sulfur content) diesel fuel is therefore required for effective functioning of many, although not all, diesel emission control strategies (DECS). New, 2007 MY engines will require ultra-low sulfur diesel fuel to enable proper functioning of the catalyzed diesel particulate filter that manufacturers will use to reduce diesel PM emissions to 0.01 g/bhp-hr.

The U.S. EPA and California adopted regulations that mandate the sale of ultra-low sulfur diesel fuel beginning July 1, 2006. One refiner, BP, has been making and selling ultra-low sulfur fuel in California since 2002. California transit agencies subject to the Fleet Rule for Transit Agencies have been required to use the fuel since July 1, 2002. Some cities have also been using ultra-low sulfur diesel fuel since it became widely available in 2002 when BP certified fuel resellers to handle the low sulfur diesel fuel, thus making the product available by truck. BP is also selling low sulfur diesel fuel through its ARCO stations that carry diesel fuel. By July 2006, ultra-low sulfur diesel fuel will be available statewide through the pipeline distribution system.

[8] Details of ARB's Period Smoke Inspection Program can be found at http://www.arb.ca.gov/msprog/hdvip/hdvip.htm

B. Verification of Diesel Emission Control Strategies

The Board adopted a procedure to verify diesel emission control strategies in 2002, codified in title 13, California Code of Regulations, Section 2700 et seq. Verification is a stamp of approval from ARB, which tells end users that the verified device achieves advertised emission reductions and is durable. The manufacturer is required to provide a warranty that includes coverage of engine damage caused by the DECS. To protect the end user, only ARB-verified DECS can be used in all of ARB's mandated programs and most of its voluntary programs.

ARB has received over one hundred applications for verification, but not all of those applications are active. The procedure requires considerable data to prove emission reductions and durability. Any DECS that uses a fuel additive must also demonstrate that it is non-toxic in all media by going through a multimedia assessment. As of September 2, 2005, ARB has verified the DECS shown in the tables below. Not all of these DECS are applicable to public or utility fleet vehicles.

Table 12. Verified Level 3 DECS

Product Name	Technology Type	PM Reduction	NOx Reduction	Applicability
Cleaire Flash and Catch CRT	DPF	85%	25%	1994+ on-road (limited - Cummins defeat device); 15 ppm sulfur diesel.
Cleaire Flash and Catch DPX	DPF	85%	25%	1994+ on-road (limited - Cummins defeat device); 15 ppm sulfur diesel.
Cleaire Longview	Lean NOx Catalyst and DPF	85%	25%	1993-2003 model year on-road; 15 ppm sulfur diesel.
CleanAIR Systems PERMIT	DPF	85%	N/A	Stationary emergency generators; 15 ppm sulfur diesel.
Donaldson	DPF	85%	N/A	1994-2002 on-road; 15 ppm sulfur diesel.
International Truck and Engine Corporation DPX	DPF	85%	N/A	1994-2003 on-road Navistar (International); 15 ppm sulfur diesel.
Johnson Matthey CRT	DPF	85%	N/A	1994-2004 on-road; 2002-2006 Cummins ISM and ISB with EGR;15 ppm sulfur diesel or B20.
Johnson Matthey CCRT	DPF	85%	N/A	1994-2004 on-road; 2002-2006 Cummins ISM and ISB with EGR;15 ppm sulfur diesel.
Johnson Matthey EGRT	EGR/DPF	85%	40%	2000 International DT-466, 2000 Cummins ISM 2001 Cummins ISB, 2001 Cummins ISC, 2001 Cummins ISL, 2001 MY DDC - 50, and 2001 DDC - 60. on-road; 15 ppm sulfur diesel.
Lubrizol ECS Purifilter	DPF	85%	N/A	1994-2003 on-road; 15 ppm sulfur diesel.
Lubrizol ECS Unikat Combifilter	DPF	85%		1996-2004 off-road; 15 ppm sulfur diesel or carb diesel.

Table 13. Verified Level 2 DECS

Product Name	Technology Type	PM Reduction	NOx Reduction	Applicability
Environmental Solutions Worldwide Particulate Reactor	Flow Through Filter	50%	N/A	1991-1993 on-road, CARB diesel.
Lubrizol PuriNOx	Alternative Fuel	50%	15%	1988-2003 on-road.
Lubrizol AZ Purimuffler/Purifier	DOC + Alt Fuel	50%	20%	1996-2002 off-road; PuriNOx

Table 14. Verified Level 1 DECS

Product Name	Technology Type	PM Reduction	NOx Reduction	Applicability
Cleaire Flash and Match	DOC	25%	25%	1993+ on-road (limited – Cummins defeat device); 15 ppm sulfur diesel or CARB diesel.
Donaldson	DOC	25%	N/A	1988-1990 on-road; 15 ppm sulfur diesel or CARB diesel.
Donaldson	DOC + crankcase filter	25%	N/A	1988-1990 on-road; 15 ppm sulfur diesel or CARB diesel.
Donaldson	DOC + crankcase filter	25%	n.a	1991+ on-road/1996 + off-road port equipment; CARB diesel.
Donaldson	DOC	25%	n.a	1991+ on-road; 15 ppm sulfur diesel.
Donaldson	DOC + crankcase filter	25%	n.a	1994+ on-road/1996 + off-road port equipment; 15 ppm sulfur diesel.
Extengine	DOC + SCR	25%	80%	1991-1995 Cummins 5.9 liter off-road; 15 ppm sulfur diesel or CARB diesel.
Lubrizol ECS AZ Purifier & Purifmuffler	DOC	25%	N/A	1991-2003 Cummins and Navistar on-road; 15 ppm sulfur diesel. 1973-1993 DDC 2 stroke; CARB diesel.
Lubrizol ECS AZ Purifier & Purifmuffler	DOC	25%	N/A	1996-2002 off-road; 15 ppm sulfur diesel.

In order to determine if a particular DECS will work with a specific engine and vehicle combination, the conditions contained in the Executive Order or Verification Letter must be followed. The EO or Verification Letter lists the engines by engine family and other conditions of verification, such as minimum engine exhaust temperature. Additional evaluations may then be needed, such as use of a datalogger that records engine exhaust temperatures over a typical duty cycle.

This list is subject to changes as additional systems are verified. The most current list of verified DECS, applicable engine families, as well as the EO and verification letters may be found on our web site at:

http://www.arb.ca.gov/diesel/verdev/verdev.htm

C. Diesel Emission Control Strategies for In-use Public and Utility Fleet Vehicles

A variety of retrofit strategies can be used for controlling emissions from in-use diesel engines. The main types of technologies discussed here are hardware, add-on technologies such as diesel particulate filters (DPF), flow through filters (FTF), or oxidation catalysts (DOC), and fuels or fuel additives.

1. Hardware Diesel Emission Control Strategies

Currently, hardware DECS consist of the DPF, including both passive and active regenerated versions, and the DOC. Each of these technology types has been used in both on- and off-road vehicles and equipment for many years. More recently, another device, a catalyzed wire mesh filter, also known as a flow-through-filter (FTF), was developed and verified.

a. Diesel Particulate Filter

A passive DPF reduces PM, and catalyzed DPFs will also reduce CO and HC emissions through catalytic oxidation and filtration. Most DPFs sold in the United States use substrates consisting either of a ceramic wall-flow monolith or a silicon carbide substrate. These substrates are either coated with a catalyst material, typically a platinum group metal, or a separate catalyst is installed upstream of the particulate filter. The filter is positioned in the exhaust stream to trap or collect a significant fraction of the particulate emissions while allowing the exhaust gases to pass through the system.

Effective operation of a DPF requires a balance between PM collection and PM oxidation, or regeneration. The volume of PM generated by a diesel engine will fill up and plug a DPF over time; thus the trapped PM must be burned off or "regenerated" periodically. Regeneration is accomplished by either raising the exhaust gas temperature or by lowering the PM ignition temperature through the use of a catalyst. The type of filter technology that uses a catalyst to lower the PM ignition temperature is termed a passive DPF, because no outside source of energy is required for regeneration.

Verified passive DPFs have demonstrated reductions in excess of 90 percent for PM, although the ARB verification Level 3 lists 85 percent PM reduction as its minimum level. A passive catalyzed DPF also reduces CO and HC by approximately the same amount as the PM reduction. A passive catalyzed DPF is a very attractive means of reducing diesel PM emissions because of the combination of high reductions in PM emissions and minimal operation and maintenance requirements.

Several passive DPF systems have been verified in California for use on a variety of diesel applications including the most popular engine series of the major engine manufacturers for model-year engines 1993 to 2004. The Executive Orders or EOs include restrictions for these verifications and a list of applications and engine families for which the device has been approved. These EOs are available at http://www.arb.ca.gov/diesel/verdev/verdev.htm

An active DPF system uses an external source of heat to oxidize the PM. The most common methods of generating additional heat for oxidation involve electrical regeneration by passing a current through the filter medium, injecting and burning additional fuel to provide additional heat for particle oxidation, or adding a fuel-borne catalyst or other reagent to initiate regeneration. Some active DPFs induce regeneration automatically on-board the vehicle or equipment when a specified backpressure is reached. Others use an indicator, such as a warning light, to alert the operator that regeneration is needed, and require the operator to initiate the regeneration process. Some active systems collect and store diesel PM over the course of a full shift and are regenerated at the end of the shift with the vehicle or equipment shut off. A number of the filters are removed and regenerated externally at a regeneration station.

For applications in which the engine-out PM is relatively high, and/or the exhaust temperature is relatively cool, actively regenerating systems may be more effective than a passive DPF. Because active DPFs are not dependent on the heat carried in the exhaust for regeneration, they potentially have a broader range of application than passive DPFs. ARB has verified Lubrizol ECS Unikat Combifilter for certain off-road applications (Executive Order DE-04-012, dated December 13, 2004). This filter is an actively regenerated non-catalyzed diesl particulate filter that is regenerated via an electrically-heated regeneration system. Currently, no active DPF systems are verified for on-road applications, although retrofit manufacturers are currently conducting field studies to verify such systems.

b. Catalyzed Wire Mesh Flow Through Filter

Flow-through filters (FTF) employ a catalyzed wire mesh substrate that has an intermix of flow channels creating turbulent flow conditions. Unlike a DPF, in which only gases can pass through the substrate, the FTF does not physically trap and accumulate PM. Instead, it acts list a DOC but achieves a greater PM reduction due to enhanced contact of PM with catalytic surfaces and longer residence times. Any particles that are not oxidized within the FTF flow out with the rest of the exhaust and do not accumulate. Consequently, the filtration efficiency of an FTF is lower than that of a DPF, but the FTF is much less susceptible to plugging because of high PM emissions and low exhaust temperatures. Therefore, this type of filter may be suitable for specific duty cycles where a typical DPF would not be applicable.

The ARB has verified the Environmental Solutions Worldwide (ESW) Particulate Reactor™ system for specific 1991 through 1993 model year diesel engines used in on-

road applications operating on standard CARB diesel fuel. The Particulate Reactor™ system employs a catalyzed wire mesh substrate to achieve at least a 50 percent reduction in particulate matter emissions, qualifying it for a Level 2 verification. Specific engine families and conditions for which the Particulate Reactor™ has been approved may be found in the Executive Order DE-04-011 (September 13, 2004) and its attachment.

c. Diesel Oxidation Catalyst

A DOC reduces emissions of CO, HC, and the soluble organic fraction of diesel PM through catalytic oxidation alone. Exhaust gases are not filtered in DOCs. In the presence of catalytic material and oxygen, CO, HC, and the soluble organic fraction of the PM undergo a chemical reaction and are converted into carbon dioxide and water. Some manufacturers integrate HC traps (zeolites) and sulfate suppressants into their oxidation catalysts. HC traps enhance HC reduction efficiency at lower exhaust temperatures and sulfate suppressants minimize the generation of sulfates at higher exhaust temperatures. A DOC may reduce total PM emissions by up to 30 percent.

On November 7, 2002, the ARB verified three Donaldson Company DECSs (Verification Letter November 7, 2002). The first system consists of the Donaldson DCM DOC muffler with 6000 Series catalyst formulation plus closed loop crankcase with Donaldson Spiracle™. The second system consists of the same Donaldson DOC but with the 6100 Series catalyst formulation. The third system resembles the second system but is applicable to different model year vehicles.

In September 2004, ARB extended the verification of the DCM DOC muffler with 6000 Series catalyst formulation alone and the DCM DOC muffler with the Donaldson Spiracle™ closed crankcase filtration system used with California diesel fuel or fuel with a lower sulfur content for model years 1988-1990 (DE-04-009 September 8, 2004).

2. Fuel-based Diesel Emission Control Strategies

Fuel-based DECS utilize the fueling system and fuel for emission reductions. All fuel-based DECS must undergo an assessment of multimedia toxicity effects by the California Environmental Policy Council as required by Health and Safety Code 43830.8 prior to ARB verification.

a. Fuel-Water Emulsion

A demonstrated alternative to diesel fuel that reduces both PM and NO_x emissions is an emulsion of diesel fuel and water. The process blends water into diesel fuel along with an additive to keep the mixture from separating. The water is suspended in droplets within the fuel, creating a cooling effect on the fuel that decreases NO_x emissions. A fuel-water emulsion creates a leaner fuel environment in the engine, thus lowering PM emissions also (U.S. EPA 2002).

Lubrizol's PuriNOx™ is verified by the ARB for 1988 through 2003 MY diesel engines used in on-road applications (Executive Order, DE-04-008, dated August 5, 2004). PuriNOx™ is an emulsified diesel fuel that achieves at least 50 percent reduction in PM and 15 percent reduction of NOx and is categorized as a Level 2 system. PuriNOx™ is verified as an emulsified mix of water and CARB diesel fuel. It is verified for use with Luribrizol ECS DOC (Executive Order, DE-04-007, dated October 29, 2004) for certain off-road engines; however it is not verified for use with any on-road hardware DECS. Lubrizol requires that fleets that use PuriNOx™ must install a recirculation pump in the products' storage tank and vehicles fueled with product must be used on a daily basis.

b. Fuel Additives

A fuel additive is a substance designed to be added to fuel or fuel system so that it is present in-cylinder during combustion and its addition causes a reduction in exhaust emissions. Additives can reduce the total mass of PM, with variable effects on PM, CO, oxides of nitrogen (NO_x) and gaseous HC production. The range of PM reductions that have been published in studies of fuel additives is from 15 to 50 percent reduction in mass. Most additives are fairly insensitive to fuel sulfur content and will work with a range of sulfur concentrations as well as different fuels and other fuel additives (DieselNet 2002).

A fuel-borne catalyst (FBC) is a substance that is added to diesel fuel in order to aid in soot oxidation in DPFs by decreasing the ignition temperature of solid carbon. An FBC can be used in conjunction with both passive and active filter systems to aid system performance, and decrease mass PM emissions. FBC/DPF systems are in wide spread use in Europe in both on-road and off-road, mobile and stationary applications and typically achieve a minimum of 85 percent reduction in PM emissions.

No fuel additive is currently verified by ARB, although some retrofit manufacturers are actively pursing verification. Fuel additives must be used with a Level 3 filter unless proven safe when used without one.

c. Biodiesel

Biodiesel is a mono-alkyl ester-based oxygenated fuel made from vegetable oils, such as oilseed plants or used vegetable oil, or animal fats. It has similar properties to petroleum-based diesel fuel, and can be blended into petroleum-based diesel fuel at any ratio. B20 is a biodiesel blend into petroleum-based diesel fuel at 20 percent. Pure biodiesel is called B100. B20, which is a common concentration used in California, would not reduce PM emissions enough to reach the Level 1 threshold of a minimum of 25 percent PM reduction. In order for a hardware DECS to be used with a biodiesel blended fuel, the DECS manufacturer must specifically request verification on this fuel. ARB has verified Johnson-Matthey, Inc. CRT Particulate Filter for use with B20 (Executive Order DE-04-06-05, dated August 15, 2005.) ARB is encouraging other hardware DECS manufacturers to similarly apply for verification of their hardward DECS on biodiesel blends.

Using publicly available data, the U.S. EPA analyzed the impacts of biodiesel on exhaust emissions from heavy-duty on-road engines (U.S. EPA 2002). While biodiesel and biodiesel blends decrease PM, HC, and CO emissions, NO_x emissions, increase proportionally with the increase of biodiesel fraction. For B20, the NO_x increase is reported to be two percent, with reductions of ten percent PM, 21 percent HC, and 11 percent CO. In addition, the U.S. EPA states a B20 blend is predicted to reduce fuel economy by one to two percent. The data were qualified with conclusions that the impact of biodiesel on emissions varied depending on the type of biodiesel (soybean, rapeseed, or animal fats) and the quality of the diesel fuel used in biodiesel blends.

Although B20 meets the definition of California diesel fuel, no biodiesel blend or B100 has been verified to reduce emissions under California's program. In order to be verified as a DECS, biodiesel fuel, like other alternative diesel fuel, must undergo a multimedia assessment.

3. Combination Systems

Systems combining a hardware and fuel strategy are under development and in-use. In order to receive ARB verification, the hardware and fuel strategy must be approved together as a system. As previously discussed, ARB has verified Lubrizol ECS's PuriNox and DOC together as a combination system (Executive Order DE-04-007).

The U.S. EPA has verified two combination systems under its voluntary program (U.S. EPA 2004b). Clean Diesel Technologies, Inc manufactures the two products U.S. EPA has verified. One is the Platinum Plus Purifier System, which is a fuel borne catalyst plus DOC verified for on-road, medium-heavy and heavy-heavy duty, 4 cycle, 1988 – 2003 MY, turbocharged or naturally aspirated engines. The other is the Platinum Plus Fuel Borne Catalyst/Catalyzed Wire Mesh Filter (FBC/CWMF) System, which is verified for on-road, medium-heavy duty, 4 cycle, 1991 to 2003 MY, non-EGR, turbocharged or naturally aspirated engines. The U.S. EPA does not assign a level for PM reduction as California does, but describes the fuel-borne catalyst plus DOC as achieving 25 to 50 percent PM reduction and the fuel-borne catalyst plus wire mesh filter as achieving 55 to 76 percent PM reduction. ARB is currently evaluating these systems under California's program. Because these systems use a fuel additive, they must to undergo a multimedia assessment prior to receiving verification.

4. In-Use Experience

Around the world, counties and cities have long required the reduction of in-use and new diesel engine emissions, with a focus on reducing diesel PM. Retrofitting offroad diesel engines with DOCs has been taking place for over 20 years; particulate filters have been in use for over ten years. In Europe and Asia, mandates have been in place and are working to clean up the air.

a. Diesel Oxidation Catalysts

In the past 20 years, over 250,000 DOCs have been installed primarily on underground mining and materials handling equipment, and over 40,000 DOCs have been installed on urban buses and on-road trucks in the U.S. and Europe. The U.S. EPA's urban bus retrofit/rebuild program required that urban buses with engines older than 1994 MY (1995 MY in California) retrofit with DOCs, resulting in over 15,000 retrofits. In addition, over 3,000 trucks have been retrofitted in Mexico and in Hong Kong about 40,000 urban buses are beginning to be retrofitted (MECA 2002, 2004b).

b. Diesel Particulate Filters

The use of DPFs is not as widespread as DOCs in part because of the requirement for very low fuel sulfur content for effective operation of a DPF. Nevertheless, MECA estimated that over 130,000 DPFs have been retrofitted on heavy-duty vehicles worldwide (MECA 2000a). One notable program is Sweden's Environmental Zone Program, which requires on- and off-road vehicles operating in specified urban areas to be retrofitted. In the U.S., California and New York have taken the lead in aggressive programs to reduce diesel PM through the use of DPFs. In addition, the City of Los Angeles adopted a motion in 2000 to require the retrofit of all city-owned diesel trucks with DPFs by February 2004.

As of September 2005, the City of Los Angeles has outfitted approximately 370 diesel Solid Waste Collection Vehicles (SWCV), 252 dual fuel (liquefied natural gas and diesel) SWCV, and 487 general service vehicles (e.g. asphalt haulers, dump trucks, sweepers, and tractors) with DPFs. The City of LA has stated that they have been satisfied with their retrofit experience, and have had few maintenance or performance problems associated with vehicles installed DPFs (Wilson, pers. comm.).

Several other public fleets have retrofitted or are actively investigating the applicability of passive DPFs in their in-use vehicles with grant money from the Carl Moyer and ERC programs. These include City of Azusa, City of Chino, Los Angeles County, City of Los Angeles Airports, Rancho California Water District, City of Cucamonga, Riverside County, City of Riverside, City of Pasadena and City of San Diego.

D. Engine Technology for Public and Utility Fleet Vehicles

1. Current Engine Availability

Heavy-duty engines sold in California are required to meet the engine exhaust standards shown below in Table 15.

Table 15. Emission Standards for New Heavy-Duty Engines

Emissions Standards (g/bhp-hr)		
Model Year	**NOx**	**PM**
Diesel Derived Engines		
1988-1989	6.0	0.60
1990	6.0	0.60
1991-1993	5.0	0.25
1994-1997	5.0	0.10
1998-2003	4.0	0.10
October 2002	2.2 (a)	0.10
2004-2006	2.2 (a)	0.10
2007-2009	1.2 (b)	0.01
2010 and subsequent	0.20	0.01
Otto Cycle Engines		
	NHMC+NOx	**PM**
2005-2007	1.0(c)	n/a
	NOx	**PM**
2008 and subsequent	0.20	0.01

a. Nominal NOx value of 2.2 g/bhp-hr is based on emission standards of 2.4 g/bhp-hr for NOx plus non-methane hydrocarbons (NMHC) or 2.5 g/bhp-hr NOx plus NMHC with 0.5 g/bhp-hr NMHC cap, which took effect in October 2002 for those engines subject to U.S. EPA Consent Decrees and the California Settlement Agreements. The Consent Decree-complying engines had to comply with 2004 standards by October 1, 2002.

b. Between 2007 and 2009, U.S. EPA requires 50 percent of heavy-duty diesel engine family certifications to meet the 0.2 g/bhp-hr NOx standard. Averaging is allowed, and it is expected that most engines will conform to the fleet NOx average of approximately 1.2 g/bhp-hr.

c. A manufacturer may request to certify to the Option 1 or Option 2 federal NOx plus NMHC standards as set forth in 40 CFR §86.005-10(f). For engine families certified to the Option 1 or 2 federal standards the Family Emission Limit must not exceed 1.5 g/bhp-hr.

Beginning with the 2007 model year, every heavy-duty engine will have to meet the 0.01 g/bhp-hr PM standard and lower NOx emission standards. The following websites provides information on MY 2005 and 2006 California certified engines:

http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2005/2005.php
http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2006/2006.php

2. Future Engine Availability (2007 – 2009)

a. Diesel-fueled Engines

All major manufactures have announced that they will be using exhaust gas recirculation (EGR) to meet the 2007 NOx emission standard and diesel particulate filters to meet the particulate standard. EGR causes a portion of the exhaust gases to circulate through a heat exchanger to cool the exhaust before reintroducing the gases into the engine intake manifold. EGR has been used in some engines since 2003, but engine manufacturers have further refined the systems to allow lower NOx emissions.

Caterpillar, Cummins, and DDC plan to offer a full line of medium- and heavy-duty diesel engines; International focuses on the school bus and collection vehicle engine markets; and Mack/Volvo focuses on engines for collection vehicles.

Dual fuel systems for collection vehicles are no longer available in the U.S., as Clean Air Power, the sole manufacturer of these systems, has concentrated its efforts in Europe. Increased interest in its product may, however, prompt Clean Air Power to develop and certify in California a 2007 product for collection vehicles.

The Diesel hybrid-electric is another technology that reduces both emissions and fuel use and that will be available in 2007. While not classified by ARB as an alternative-fuel technology, diesel hybrid-electric technology achieves lower emissions and better fuel economy than equivalently sized diesel buses or trucks. Emissions testing studies at ARB and other facilities indicate a fuel consumption reduction of 25 percent and NOx emission reduction of about 50 percent for diesel-fueled hybrid-electric buses (HEBs) compared to conventional diesel transit buses. This technology is being applied primarily in delivery vehicles and transit buses.

b. Alternative-fuel Engines

Manufacturers of natural gas engines are likely to be able to meet the upcoming 2007 standard with three-way catalyst aftertreatment technology similar to that being used on passenger cars. Cummins, through its joint partnership with Westport Innovations, Cummins Westport Inc., and John Deere has stated they will offer alternative fuel products to meet the 2007 emission standards. Although we have only preliminary data, it appears that these manufacturers of alternative-fuel engines or systems will certify to the more stringent 2010 0.20 g/bhp-hr NOx and 0.01 g/bhp-hr PM standards.

John Deere currently only certifies urban bus and medium heavy-duty natural gas engines, but is developing a heavy heavy-duty engine that could be suitable for use in waste collection vehicles. John Deere has stated is intends to produce a 250-325 horsepower, 9 liter natural gas engine meeting the 0.20 g/bhp-hr NOx level by 2007. This engine could be used in transit buses, school buses, and refuse trucks.

Cummins will be marketing the natural gas engines developed by Cummins Westport Inc. Cummins is currently providing bids on both diesel and natural gas buses for 2007. Cummins Westport Inc. has partnered with U.S. DOE's NREL to develop a lower emission version of the L Gas Plus (8.9 L) engine for use in medium-duty trucks, refuse trucks, and urban buses. This engine is scheduled to be commercially available in early-2007. The SCAQMD is also currently sponsoring a project with Cummins to commercialize the C Gas Plus engine (8.2 L) to 0.2 g/bhp-hr NOx by 2007.

In 2004, Ford and General Motors stated that they would no longer be producing their smaller CNG engines used in cutaway vehicles. As a result, BAT Technologies, Clean Energy, and Teleflex/GFI Control Systems have jointly proposed a contract with the SCAQMD and the state of New York to "develop and certify in California a retrofit system that converts 2005 and subsequent model year gasoline-powered Ford Crown Victoria and E-450 cutaway vehicles to dedicated CNG operation" (South Coast Air Quality Management District, 2004). It is anticipated that once retrofitted, the engines will meet SULEV emission levels. This technology is scheduled to be certified by mid-year 2005.

ISE Corporation currently offers a California-certified gasoline hybrid electric bus and is developing hybrid electric systems with compressed natural gas, diesel, and hydrogen fuels, also for urban buses. While ISE focuses on the urban bus market, it is considering expanding into other vocations that use heavy heavy-duty engines, such as waste collection vehicles.

c. Gasoline Engines

Emission standards for heavy duty Otto-cycle engines used in heavy-duty vehicles over 14,000 GVWR for model year 2007 are 1.0 g/bhp-hr NMHC+NOx with no PM standard. Beginning in model year 2008 the emission standards are lowered to 0.20 g/bhp-hr for NOx and 0.01 g/bhp-hr for PM. It is expected that only minor modifications to current gasoline engine technology will be required to meet these standards.

3. Engine Availability (2010 and beyond)

Engine technology for 2010 will most likely rely upon selective catalytic reduction (SCR), NOx adsorbers, and further improvements in engine technology to reduce NOx emissions.

Two aftertreatment technologies that will most likely play a large role in meeting the 2010 NOx standard are selective catalytic reduction (SCR) and the NOx adsorber.

SCR catalysts use ammonia as a NOx reductant to reduce stationary sources emissions. Urea may also used as the source of ammonia. In recent years, considerable effort has been invested in developing urea SCR systems that could be applied to heavy-duty diesel vehicles with low sulfur diesel fuel. Urea SCR systems are being used to comply with the EURO IV heavy-duty diesel emission standards

(U.S. EPA, 2004b). U.S. manufacturers are working on SCR systems for vehicles that could be used in 2010.

Unlike catalysts, which continuously convert NOx to N_2, NOx adsorbers are materials that store NOx under lean conditions and release and catalytically reduce the stored NOx under rich conditions. NO and NO_2 are acidic oxides and can be trapped on basic oxides. Fuel sulfur can be converted to stable sulfates providing competition with NOx for storage sites, thus poisoning the catalysts, therefore low sulfur fuel is required.

E. ARB Exhaust Temperature Study

From October 2003 to July 2004, ARB conducted an exhaust temperature study to evaluate the various vehicle types that are typically used by municipalities and/or utilities. The study's goal was to determine what percent of the vehicles have the operational characteristics to use DECS that rely on exhaust temperature to function properly.

Based upon the study, ARB determined that at least 56% of the vehicles meet the criteria for Level 3 passive DPFs, 67% of the vehicles meet the temperature criteria for the Level 2 Flow Through Filter, and 96% met the temperature criteria for a Level 1 DOCs. Details of the study can be found in Appendix D**.** Overall the study shows nearly all vehicles could use a temperature dependent DECS; provided adequate space is available for device installation.

F. Implementation Assistance

Staff is committed to provide the necessary compliance assistance to fleets for successful implementation of the rule. Upon adoption of the rule, staff is prepared to conduct statewide workshops, develop compliance guidance documents, sample recordkeeping forms and labels to assist fleets with implementation. All these activities are consistent with ARB's efforts with other fleets rules already adopted. In addition, staff is also working on developing an interactive web-based "look-up" table to help fleets identify verified DECS that may be applied to a vehicle based upon engine manufacturer and model-year.

VII. REGULATORY ALTERNATIVES

Staff believes the proposed regulation is the most cost efficient method for reducing diesel PM from municipality and utility fleet vehicles. A comparison of emission reductions from each regulatory alternative considered can be found at the end of this section (Table 16).

A. Do Not Adopt This Regulation

Not adopting this regulation would disregard the adverse health risk posed by diesel PM. In consideration of the potential health impacts discussed earlier, and ARB's mandate to protect the public health of all Californians, this alternative is not considered a reasonable option. ARB staff does not recommend this alternative because it would result in approximately 80 percent greater PM emissions over the next few decades than the proposed plan, thus adversely impacting the health of Californians.

With full implementation of this control measure, the estimated reduction in diesel PM ranges from 78 percent in 2010, to 84 percent in 2020, when compared to the 2000 PM baseline. The recommended actions in this plan will reduce the localized risks associated with activities that expose nearby individuals to diesel PM emissions. This diesel PM control measure will result in additional benefits associated with reducing diesel PM emissions, including reducing NOx emissions by 35% percent from baseline in 2020, reducing ambient fine PM levels, increasing visibility, reducing material damage due to soiling of surfaces, and reducing incidences of non-cancer health effects, such as bronchitis and asthma.

B. Rely on Voluntary Programs

The federal rules for new diesel engines will not be implemented for several years and do not affect existing vehicles. The U.S. EPA developed the Voluntary Diesel Retrofit Program to reduce diesel PM emissions in the immediate future. The program addresses pollution from diesel construction equipment and heavy-duty vehicles on the road today by providing a voluntary certification program for technology. Participation is voluntary and available incentive funds are currently limited. The U.S. EPA program is not sufficient for meeting ARB's overall goals.

The Carl Moyer Program is a California program which encourages use of cleaner engines by funding the incremental cost of repower, retrofit, or purchase of new, cleaner engines. Although the Moyer Program is funded at approximately $140 million per year for the next 10 years, participation is still voluntary, available incentive funds are limited and it does not require fleets to clean up their existing fleet.

Therefore, given the over 1.2 million diesel engines in California, reliance on purely voluntary programs is inadequate for meeting California's risk reduction goals. ARB staff does not recommend this alternative because it would result in only minor diesel PM emission reductions.

C. Require Repowered Engines or New Vehicle Purchases

Another alternative staff considered, which would result in similar reductions in diesel PM emissions, is to require all public and utility fleet vehicles to repower with diesel engines certified to the 0.01 g/bhp-hr particulate standard beginning in 2007. This option is significantly more expensive than the proposed alternative. The estimated

capital cost of repowering all engines in 2007 is approximately $650 million, which is three times higher than the $213 million cost to implement this proposed regulation, for a similar reduction in diesel PM. The estimated cost could be even higher than this as many vehicles cannot be repowered. A repower may be incompatible with older engine and drive train technology or the size of the engine compartment, thus the owner would have to purchase a new vehicle to accomplish the lower PM emissions.

Staff predicts a complete turnover of public and utility vehicles by 2020 would reduce diesel PM emissions by up to 90 percent. This is an estimated reduction of 0.06 tpd, which is slightly higher than the recommended alternative in 2020 (Table 16). ARB staff does not recommend mandating this as the sole option, however, because of the high cost of implementation compared to the amount of PM emissions reduced and significantly poorer cost effectiveness.

D. Require Alternative Fuel

The last alternative staff considered but did not recommend was the requirement to repower all applicable vehicles with alternative fueled engines. This would have resulted in the same PM reductions as the alternative to repower with all 2007 engines; however it may result in a small NOx benefit from 2007 to 2009. ARB staff does not recommend mandating this as the sole option, however, because of the limited alternative fueled engine availability for public and utility fleet vehicles, and the high cost of implementation compared to the amount of PM emissions reduced and significantly poorer cost effectiveness.

Table 16. Diesel PM Reductions by Alternative Compared to the Proposal.

Year	Proposal (tpd)	Regulatory Alternatives Reductions (tons/day)			
		Adopt Nothing	Voluntary	Repower to 0.01 Engine	Alt Fuel Engines
2010	**0.15**	0	n.q.	0.13	0.13
2020	**0.05**	0	n.q.	0.06	0.06

n.q. – not quantified

VIII. ECONOMIC IMPACT

The total discounted cost of the rule in 2005 dollars for all municipalities and utilities is $213 million. This cost is to apply BACT to approximately 31,076 vehicles (estimated to be in the fleet in 2006). The cost per vehicle is estimated at $6,857. This is lower than the estimated cost per truck of $13,000 for implementation of the solid waste collection vehicle rule adopted by the Board in 2003.

A. Legal Requirement

Sections 11346.3 and 11346.5 of the Government Code require state agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination, or creation, and the ability of California business to compete.

State agencies are also required to estimate the cost or savings to any state or local agency and school districts in accordance with instruction adopted by the Department of Finance. This estimate is to include any nondiscretionary costs or savings to local agencies and the costs or savings in federal funding to the state.

B. Affected Manufacturers

No manufacturer will incur any direct costs as a result of this proposed rule because it only applies to government agencies and utilities that operate fleets, and their choices on purchasing existing engines and emission control technologies.

C. Estimated Costs to Investor-Owned Private Utilities

Staff estimates a total of 209 private utilities operating an estimated 3,979 vehicles as of 2004 will be impacted by this regulation. Staff collected data from the four largest investor-owned private utilities that provide natural gas, electricity and/or water services in California. These four large utilities account for 3,130 vehicles that are subject to this rule. In addition, staff identified about twenty additional utilities with 664 vehicles from the ARB PSIP database. Lastly, staff identified about 185 small water companies from the California Public Utilities Commission's (CPUC) lists. Telephone contact with these small water companies shows that on average they have about one vehicle per company that may be impacted by this regulation.

Staff does not have access to financial records for any investor-owned utilities; therefore the number of vehicles owned by a company was used as a surrogate to determine small business status. The criteria staff used for a small business was a company that owns fewer than 15 vehicles. Based on these criteria, staff determined that all small water companies would be considered small businesses, which is 88 percent of the total companies potentially directly affected by this regulation but less than one percent of the total California municipal and utility fleet vehicles.

1. Retrofit Implementation Scenario

Staff assumed utility vehicle owners would choose the least expensive of the best available control technologies to comply with this regulation. Staff, therefore, assumed a diesel emission control strategy would be employed in lieu of more expensive options of repowering or replacing the vehicle or engine, unless that was the only option

available to those vehicles or the fleet operator needed to replace the vehicle in the near future for other reasons. Typically, particulate matter (PM) emissions and exhaust temperatures dictate the type of diesel emission control strategy a vehicle can use. Based on available data on DECS currently available to the vehicle fleet, staff created a "most-likely" retrofit scenario to determine an average economic impact (Table 17).

This scenario is based on those DECS that are expected to be available during the implementation period (Table 18). DECS include Level 3 verified diesel particulate filters; Level 2 verified flow through filters and a fuel-water emulsified fuel; and Level 1 verified technology of a diesel oxidation catalysts. Table 18 also includes an active DPF[9]. The only other technologies available to these vehicles are engine repower or replacement. The scenario assumes more Level 1 technologies will be verified, and for current verified Level 1, 2 and 3 technologies to have verifications extended to additional MY engines.

[9] Active DPFs do not rely on exhaust temperature for regeneration, thereby having a wide range of retrofit applications.

Table 17. Most-Likely Verification Retrofit Scenario[g]
(Applies to Municipal and Utility Fleets)

Group	MY	%BACT	Implementation Date	Level 1[a]	Level 2[d]	Level 3	Repower
1	1960-1987[e]	20%	12/31/2007		10%		8%
		60%	12/31/2009				28%
		100%	12/31/2011			11%	33%
		Delay	12/31/2012				10%
2a	1988-1993	20%	12/31/2006	5%	5%	8%	
		60%	12/31/2008	2%	10%	25%	
		100%	12/31/2010			35%	
		Delay	12/31/2011			10%	
2b	1994-2002[d, f]	20%	12/31/2006	5%	5%	8%	
		60%	12/31/2008	2%	10%	25%	
		100%	12/31/2010			35%	
		Delay	12/31/2011			10%	
3	2003-2006[b,c]	50%	12/31/2009		20%	30%	
		100%	12/31/2010		20%	30%	

Notes:
[a]Assumes current Level 1 verification will be extended to 1960-1993 model years.
[b]Assumes current Level 3 verification will be extended to 2003-2006 model years.
[c]Assumes current Level 1 verification will be extended to 2003-2006 model years.
[d]Assumes current Level 2 verification will be extended to all model years
[e]Assumes a Level 3 verification will be available for some 1960-1987 model years.
[f]Assumes a Level 3 active DPF verification will be available for some 1988-2002 model years.
[g]Percentage add to 100% for each model year group

2. Implementation Costs

The initial cost per truck will vary depending on the best available control technology used for the truck. The initial costs listed in this section are based on capital and operation and maintenance costs applied to the retrofit scenarios discussed in the previous paragraph. Capital costs per vehicle and technology are listed in Table 18. Staff assumed that the only capital cost required for the fuel-water emulsion option is for one fuel re-circulation pump per terminal since it is assumed that fleets that use this operation already have an existing fuel tank on-site. No additional cost was added for those DECS that specify use of ultra-low sulfur fuel because the federal and state ultra low sulfur diesel fuel rule will be effective for all on-road diesel vehicles as of July 1, 2006 (six months prior to the first implementation deadline).

Table 18. Average Capital Costs for Diesel Emission Control Strategies

COST DESCRIPTION			
DECS	**Low**	**High**	**Average**
Passive Diesel Particulate Filter	$6,000	$11,000	$8,500
Diesel Oxidation Catalyst	$1,000	$2,000	$1,500
Flow Though Filter	$3,500	$6,500	$5,000
Fuel Recirculation Pump/Terminal	$1,000	$10,000	$4,000[10]
Lean Nox Catalyst with DPF	$13,000	$17,000	$15,000
Active DPF	$10,000	$12,500	$11,000
EGR+DPF	$14,000	$18,000	$16,000

Table 19. Incremental Annual Operation and Maintenance Costs for a Retrofitted Municipality or Utility Vehicle

Cost Description	Average Cost for Passive and Active DPF and Oxidation Catalyst	Average Cost for Fuel-Water Emulsion	Average Cost Savings for Engine Repower[c]
Maintenance	$33 [a]	$0	<$176>
Fuel[b]	$0	$355	<$264>
Total:	$33	$355	<$440>

Notes:
[a]Includes increased cleaning and maintenance estimated at 1 hour for diesel particulate filters and oxidation catalyst crankcase filter replacement interval required once per three years based upon low mileage accumulation.
[b]Incremental fuel cost if a fuel-based DECS is selected.
[c]Decreased maintenance and fuel costs are associated with the use of new engines.

The average total statewide dollar costs were then derived from the application of the average discounted capital costs plus the average operation and maintenance costs from FY 2006 to 2022 for the most-likely retrofit implementation scenario, totaling approximately $28,390,000 (Table 20) for the retrofit of the total number of utility vehicles expected to be in the fleet in 2006 (approximately 4,140 vehicles).

Staff developed average capital costs for each BACT option listed in the most-likely retrofit scenario (Table 17). Staff surveyed various retrofit manufacturers and installers to get an average cost for a level 1, 2, and 3 DECS. Staff also surveyed engine dealerships and fleets to get an average cost to repower a diesel vehicle. These capital

[10] Based upon most common size fuel pump utilized by fleets, Lubrizol 2004.

costs were discounted over the period of ten years for the DECS or repower. See small businesses section below for complete description of how costs were derived and Appendix C for more detailed retrofit cost assumptions.

Table 20. Average Total Statewide Costs of Most-Likely DECS Verification Implementation Scenarios for Utilities

Fiscal Year	Discounted Average Annual Capital Costs (in 2005 dollars)	Average Annual O&M Costs (in 2005 dollars)	Total Average Annual Cost (in 2005 dollars)
2006	$333,000	$35,000	$368,000
2007	$806,000	$53,000	$859,000
2008	$1,520,000	$43,000	$1,563,000
2009	$2,188,000	$19,000	$2,207,000
2010	$2,932,000	-$22,000	$2,910,000
2011	$3,162,000	-$39,000	$3,123,000
2012	$3,115,000	-$60,000	$3,056,000
2013	$2,912,000	-$56,000	$2,856,000
2014	$2,721,000	-$52,000	$2,669,000
2015	$2,543,000	-$49,000	$2,494,000
2016	$2,208,000	-$64,000	$2,144,000
2017	$1,811,000	-$70,000	$1,742,000
2018	$1,303,000	-$59,000	$1,244,000
2019	$828,000	-$47,000	$781,000
2020	$323,000	-$24,000	$299,000
2021	$87,000	-$13,000	$75,000
2022	$0	$0	$0
Total:	$28,792,000	-$405,000	$28,390,000

Capital and operation and maintenance costs will vary depending on the year of implementation, due to the phase-in schedule. Staff expects the costs to be borne by the end user, since this is a regulation requiring retrofits of in-use vehicles.

D. Potential Impact on Utilities

The average cost per vehicle for small utilities and typical utilities are the same. The average investor-owned private utility company has approximately five vehicles to which this rule applies, while the four largest investor-owned utilities have an average of 783 vehicles each to which this rule applies. Staff chose to calculate the average cost using five vehicles. The average size for a typical fleet was calculated by taking the total number utility vehicles (4,140) and subtracting the percentage of vehicles owned by large utilities (79%). This number (869) was then divided by 205 which is the number of private utilities if the four largest utilities are not included.

Staff assumed 22 percent of the vehicles would fall under 1960-1987 MY (Group 1) engines, 74 percent of the vehicles would fall under 1988-2002 MY (Group 2) engines,

and 4 percent would fall under the 2003-2006 MY (Group 3) engines for implementation phase-in, based on survey information. The capital costs, and operating and maintenance costs are listed in Table 21 for the years of implementation, FYs 2006 to 2011.

Table 21. Initial and Annual Costs Average Small Utility with 5 Vehicles

Fiscal Year	Discounted Average Annual Capital Costs (in 2005 dollars)	Average Annual O&M Costs (in 2005 dollars)	Total Average Annual Cost (in 2005 dollars)
2006	$402	$43	$444
2007	$974	$64	$1,038
2008	$1,836	$51	$1,888
2009	$2,642	$23	$2,665
2010	$3,541	-$26	$3,514
2011	$3,819	-$47	$3,772

In order to arrive at the discounted capital costs for the small/typical business, staff annualized the capital costs by multiplying the net present value of the capital costs by the capital recovery factor.[11] Staff assumed a lifetime of the DECS based on a minimum lifetime of ten years with an annual interest rate of seven percent.[12] It is quite likely that a DECS will last much longer in a well-maintained vehicle, as some DECSs have been operating for over ten years on solid waste collection vehicles in Europe.[13]

To determine the operation and maintenance costs in current dollars, staff multiplied the yearly costs by the net present value factor. Also, the operation and maintenance costs are higher than would be expected with just hardware DECS used, because the fuel-water emulsion DECS is included the overall operation and maintenance costs at an average of $355 per vehicle annually, and not all utilities will utilize this option.

[11] Net Present Value is the cost multiplied by 1/(1+r)^(n+1), where r = the annual interest rate, and n = the number of years in the future. For example, FY2004-2005 is considered to be n = 0, and for FY 2005-2006 n = 1. Capital Recovery Rate Factor is (r*(1+r)^N)/[(1+r)^N-1], where r = the annual interest rate, and N = lifetime of project (in years) (Linsley, 1977).

[12] For federal decision-making, Office of Management and Budget suggests using this annual interest rate. (OMB Circulate A-94, http://www.whitehouse.gov/omb/circulars/a094/a094.html)

[13] Bauner, David. March 2002. Raw data submitted to ARB for contract to determine European retrofit experience.

E. Potential Impact on Businesses

The regulation allows municipalities and utilities a variety of options to meet the proposed regulation requirements. The proposed regulation may have some cost impact on companies involved in the manufacture and production of engines and vehicles by creating the need for new engines and vehicles.

While this regulation applies to existing businesses and uses technology from existing businesses, it may lead to the creation of businesses. Businesses that may be created include those that manufacture DECS and those that install, repair, or clean DECS. Staff believes businesses will be altered or augmented in lieu of creating new businesses. Some used trucks businesses; however, may be adversely affected because these businesses may experience a reduction in demand for their used truck services. Staff believes, however, that these businesses are likely to change their business focus to refurbishment and upgrading of engines for resale.

Specific to the retrofit requirements, California businesses capable of performing engine retrofits will be positively affected with increased workload. There are seven DECS manufacturers located in California that may be positively affected by this regulation.

F. Potential Impact on Business Competitiveness

The proposed regulation is not expected to impact the ability of California businesses to compete with businesses in other states because utilities generally do not compete with each other because each has their own specific service territories. As indicated above, many of the businesses that produce the products needed to meet the proposal are located in other states. By requiring new, clean technology, this proposal may actually provide new opportunities for California businesses engaged in advanced technology. Utilities providing water, natural gas and electricity services will remain in California to provide effective and efficient services to their customers.

G. Potential Impact on Employment

The proposed regulation will likely create a market for manufacturers of heavy-duty diesel or natural gas engines, vehicles, and emission control systems. For those businesses located in California, the creation of new jobs is expected to meet this demand. Services to retrofit existing public and utility vehicles are expected to create new opportunities for existing businesses.

H. Potential Impact on Business Creation, Elimination or Expansion

The proposed regulation could impact California companies involved in the manufacture and production of engines, vehicles, and DECS. Currently seven DECS manufacturers and numerous OEM dealerships are located in California. Allowing new, cleaner engine and vehicle purchases as a means to meet the diesel PM control measure could create

new business opportunities for manufacturers of heavy-duty diesel, natural gas, or gasoline engines, vehicles, and DECS.

I. Potential Costs to Local Agencies

The proposed regulation is expected to have a significant impact on public agencies statewide that own and operate diesel-fueled vehicles. The average total statewide dollar costs for local agencies (i.e., city, county and special districts) were derived from the application of the average discounted capital costs plus the average operation and maintenance costs from FYs 2006 to 2022. Implementing the retrofit scenario (Table 17) would cost approximately $156.6 million for the retrofit of approximately 22,839 vehicles expected to in the fleet by 2006. Capital costs were discounted over the period of ten years for the DECS.

The average discounted costs for the first year of implementation in FY 2006 are $2,030,000 (Table 22). The average annual costs are based on discounted average capital costs plus average operation and maintenance costs (Table 18 and 19) for the most-likely DECS verification implementation scenario.

In order to arrive at the discounted capital costs for the proposed regulation, staff annualized the capital costs by multiplying the net present value of the capital costs by the capital recovery factor.[14] Staff assumed a lifetime of the DECS based on a minimum lifetime of ten years with an annual interest rate of seven percent.[15] It is quite likely a DECS will last much longer in a well-maintained vehicle, as some DECS have been operating for over ten years in vehicles in Europe without replacement.[16]

To determine the operation and maintenance costs in 2005 dollars, staff multiplied the yearly costs by the net present value factor. The cost analysis assumes a fleet composition of 22 percent of the Group 1 vehicles; 74 percent of the Group 2 vehicles; and 4 percent of the Group 3 vehicles, and a retrofit scenario shown in Table 17. Staff estimates 22,839 vehicles are owned by local public agencies throughout California, and 3,087 vehicles would be brought into compliance in FY 2006.

[14] Net Present Value is the cost multiplied by 1/(1+r)^(n+1), where r = the annual interest rate, and n = the number of years in the future. For example, FY2003-2004 is considered to be n = 0, and for FY 2004-2005 n = 1. Capital Recovery Rate Factor is (r(1+r)^N)/[(1+r)^N-1], where r = the annual interest rate, and N = lifetime of project (in years) (Linsley, 1977).

[15] For federal decision-making, Office of Management and Budget suggests using this annual interest rate. (OMB Circulate A-94, http://www.whitehouse.gov/omb/circulars/a094/a094.html)

[16] Bauner, David. March 2002. Raw data submitted to ARB for contract to determine European retrofit experience.

Table 22. Average Local Government Costs to Implement Public and Utility Fleet Vehicle Regulation

Fiscal Year	Number of Vehicles Retrofit	Discounted Annual Capital Costs (in 2005 dollars)	Average Annual O&M Costs (in 2005 dollars)	Total Average Annual Cost (in 2005 dollars)
2005	0	$0	$0	$0
2006	3,087	$1,835,000	$195,000	$2,030,000
2007	3,416	$4,448,000	$292,000	$4,740,000

J. Potential Costs to State Agencies

Two separate costs may pertain at the state government level: costs to state agencies that own diesel vehicles to bring the vehicles into compliance, and costs for the ARB to implement and enforce the regulations. ARB estimates three additional staff will be required to enforce the regulation and to provide guidance for implementation. The cost for three additional ARB staff is approximately $300,000 annually. Staff anticipates the need for added staff beginning FY 2005.

According, to DMV registration data, the State of California owns approximately 1,275 diesel-fueled vehicles as of 2004; however this number is expected to grow to approximately 1,327 vehicles by 2006. The total cost to the state just to bring these vehicles into compliance is approximately $9.1 million. If we include the cost to the state to implement and enforce the regulation, the initial discounted cost for FY 2006 would be $418,000. Assuming the cost of compliance is discounted over ten years, the estimated cost of compliance for California for current fiscal year and the next two fiscal years are shown below (Table 23):

Table 23. Average Costs to the State to Implement Municipality and Utility Fleet Regulation

Fiscal Year	Number of Vehicles Retrofit	Discounted Annual Capital Costs (in 2005 dollars)	Average Annual O&M Costs[17] (in 2005 dollars)	Total Average Annual Cost (in 2005 dollars)
2005	0	$0	$300,000	$300,000
2006	179	$107,000	$311,000	$418,000
2007	198	$258,000	$317,000	$575,000

Most state agencies will have to absorb the cost of compliance in their general budget since they do not charge specific fees for services provided by their diesel vehicles (e.g., CalTrans freeway sweeping.)

[17] O&M costs include vehicle retrofit costs and costs to implement and enforce the regulation.

K. Cost to Federal Agencies

Staff was unable to determine the exact number of vehicles owned by the federal government operating in California, since most are not registered by the DMV. However, the United States Postal Service, several military bases, and the federal General Services Administration submitted survey data on their vehicles subject to the rule. Based on these, staff estimated the total federal fleet vehicles subject to the rule is 2,663 as of 2004. This number is expected to grow to approximately 2,771 by 2006. The total cost for federal agencies discounted to 2005 dollars is estimated at $19 million.

L. Cost to Municipalities and Utilities Located in Low Population Counties

Municipalities and utilities located in low population counties typically have older vehicles. Based on an analysis DMV data, approximately 1,070 municipal and utility vehicles subject to the rule are registered in low population counties. Forty-six percent (46%) are Group 1 vehicles, 54% are Group 2 vehicles, and less than 1% are Group 3 vehicles. The majority of Group 1 vehicles will likely be replaced as shown in the retrofit scenario in Table 17 since these are less amenable to retrofit. The total discounted cost for these fleets is estimated at $9.2 million if they do not select any optional compliance schedule.

Based on discussion with these fleets and the Regional Council of Rural Counties, staff assumes most fleets will take advantage of the optional implementation schedule in Table 11 or the accelerated turnover option. This would result in a lower discounted total cost since the full implementation period is extended out a minimum six years (depending what option is selected.)

M. Cost to the Average Household for Utilities

Utilities have the ability to pass the cost of compliance on to their ratepayers. Some special districts also provide services on a fee basis (i.e., water district) and may be able to pass on the cost of compliance to their ratepayers. A utility ratepayer may eventually pay higher costs for natural gas, electric or water services.

To estimate an order of magnitude for the cost to an individual ratepayer, staff calculated the average increase to an individual ratepayer for the largest utility in California. This utility owns approximately 1,472 vehicles subjected to the regulation as reported to ARB in 2004 (this number is estimated to grow to 1,531 vehicles by 2006). The total cost of compliance discounted to 2005 dollars is $10.5 million. If this cost was equally distributed to the 4,756,159 utility's customer accounts[18], it would result in a one time increase per ratepayer of $2.20.

[18] California Public Utility Commission 2001 Utility Electric Sales

IX. ENVIRONMENTAL IMPACT AND COST-EFFECTIVENESS

The proposed regulation would provide cost-effective diesel PM emission reductions throughout California, especially at the neighborhood level. The air quality benefits statewide would be not only from reduction of diesel PM emissions, but also from reduction of CO, NO_x, and HC emissions. Staff calculated the average cost per diesel PM pound reduced by 2010 is about $159 and the average cost per NOx pound reduced is $11.47

The cost-effectiveness of this regulation is higher than other similar PM control measures; however the health benefits of the regulations provides a cost savings as discussed in section IX.C.

A. Statewide Emission Benefits

ARB staff estimates the proposed diesel PM control measure would result in the reduction of between 0.15 tpd of diesel PM emissions in 2010 and 0.05 tpd diesel PM reduced in 2020 (Table 24). The reduction of diesel PM emissions attributed to this regulation peaks around 2010 because the majority of vehicles are expected to meet the diesel PM control measure by 2010 (except for about 1,070 vehicles located in low-population counties, which have a later final implementation date). After 2010 the benefits attributed to this regulation decline to 0.05 tpd in 2020 as vehicles are retired and replaced with new engines that meet the federal 2007 0.01 g/bhp-hr PM standard.

Table 24. Statewide Diesel PM Emission Reduction Benefits.

Calendar Year	Baseline Inventory (tpd)	Diesel PM Retrofit Reduction (tpd)	% Reduction from Baseline
2006	0.36	0.02	6%
2010	0.25	0.15	60%
2015	0.17	0.10	59%
2020	0.12	0.05	42%

Other air quality benefits also exist as a result of the use of the various BACT, including reduced emissions of CO, HC, and NOx. The reductions in HC are also accounted for in the State Implementation Plan. Based on expected reduction capabilities from the various DECS that might be used (Table 25), reductions of up to 1.18 tons of CO per day (Table 26), 0.15 tons of HC per day (Table 27), and 0.30 tons of NOx per day (Table 28) will be realized .

Table 25. Other Pollutant Reductions

Diesel Emission Control Strategy	Emission Reduction (Percent)			
	PM[a]	CO	HC	NO_x
Passive Diesel Particulate Filter	85	90[b]	95[b]	0[c]
Fuel-Water Emulsion[h]	50	35[d]	60[d]	50[d]
Average Diesel Oxidation Catalyst	25	47[e, f]	76[e, f]	0[c]

[a]Verified Level Reduction Goals for ARB. Strategies will not be verified without meeting this standard at a minimum.
[b]Allansson, R, Cooper, BJ, Thoss, JE, Uusimaki, A, Walker, AP, Warren, JP. 2001. European Experience of High Mileage Durability of Continuously Regenerating Diesel Particulate Filter Technology. SAE. 2001-01-0480.
[c]Majewski, W. Addy. 2001. Diesel Net Technology Guide: Diesel Particulate Traps. www.dieselnet.com.
[d]Diesel Net Technology Guide: Emission Control Technologies, 1998. www.dieselnet.com.
[e]Diesel Net Technology Guide: Diesel Oxidation Catalyst, 1999. www.dieselnet.com.
[f]Khair, Magdi; McKinnon, Dale L. Performance Evaluation of Advanced Emission Control Technonlogies for Diesel Heavy-Duty Engines. SAE. 1999-01-3564.
[h]Fuel-water emulsion increases CO and HC emissions. Although can be verified alone for the purposes of simplifying calculations, assumed it would be used in conjunction with a diesel oxidation catalyst to decrease impact of increase. Choose least decrease to account for offset of increase from fuel-water emulsion.

Table 26. Statewide Diesel CO Emission Reduction Benefits

Calendar Year	Baseline Inventory (tpd)	Diesel CO Reduction (tpd)
2006	2.2	0.17
2010	2.0	1.18
2015	1.8	0.85
2020	1.6	0.46

Table 27. Statewide Diesel HC Emission Reduction Benefits

Calendar Year	Baseline Inventory (tpd)	Diesel HC Reduction (tpd)
2005	0.27	0.02
2010	0.23	0.15
2015	0.20	0.11
2020	0.16	0.05

Table 28. Statewide Diesel NOx Emission Reduction Benefits

Calendar Year	Baseline Inventory (tpd)	Diesel NOx Reduction (tpd)
2006	11.2	0.03
2010	10.1	0.30
2015	8.5	0.18
2020	7.3	0.09

B. Impacts on the State Implementation Plan for PM_{10}

The draft State Implementation Plan (SIP) for in the San Joaquin Valley projects attainment for the federal PM10 standard by 2010. As a "serious" nonattainment area, the San Joaquin Valley must use best available control measures for all sources of PM_{10} and must also achieve five percent annual emission reductions in PM_{10} and its precursors. The San Joaquin Valley has ten percent of the statewide municipal and utility vehicles and will see a benefit of 0.02 tpd of PM reduced by 2010. In addition, the NOx and volatile organic carbon (VOC) benefits of the proposed rule are contained in the plan, as they are precursors to secondary PM formation.

The South Coast air basin is also classified as "serious" for PM_{10} but its attainment deadline is 2006, before most of the benefits of the proposed rule will be achieved. Nonetheless, the proposed rule will help that District maintain compliance with the federal PM_{10} standard. The rule also serves as a down payment on future plans to achieve the federal $PM_{2.5}$ standards and California's own, more stringent standards. Thirty-five percent of California's public and utility fleet vehicles are in the South Coast region. By 2010, the proposed rule will reduce emissions from those vehicles by 0.05 tpd.

All other PM_{10} nonattainment areas in California will benefit from the proposed rule in a general way. Every district except Lake County is in nonattainment for the California PM_{10} standard. In addition, four other areas in California are nonattainment for the federal PM_{10} standards: Owens Valley, Searles Valley, Coachella Valley, and Imperial Valley.

For ozone SIPs there is a similar situation. The ARB adopted the statewide element and approved the comprehensive SIP for the South Coast Air Basin and the PM10 SIP for the Coachella Valley on October 23, 2003. ARB submitted the South Coast and Coachella SIPs to U.S. EPA on January 9, 2004.

As with PM_{10}, all other ozone nonattainment areas in California will benefit from the proposed rule in a general way as it reduces the precursors to ozone formation (see Tables 27 and 28).

C. Health Benefits of Reductions of Diesel PM Emissions

This section examines the health benefits of reducing diesel PM emission and provides an analysis of the number of premature deaths prevented by the reduction of diesel PM. It also provides the cost savings to society for each prevented premature death. In addition, a brief discussion of health benefits of reducing ozone precursors is included.

Staff estimates that approximately 40 premature deaths will be avoided from the implementation of this proposal. The proposed regulation is expected to reduce $PM_{2.5}$ emissions by a cumulative amount of 538 tons by the end of year 2022, and therefore prevent an estimated 38 premature deaths (19 - 57, 95 percent confidence interval (95% CI)) by year 2022. In addition, staff estimates that the proposed regulation is expected to accrue a cumulative reduction of 1,005 tons of NOx by the end of 2022, therefore avoiding an estimated 2 premature deaths (1 – 2, 95% CI).

Lloyd and Cackette estimated that, based on the Krewski *et al.* study[19], a statewide population-weighted average diesel $PM_{2.5}$ exposure of 1.8 $\mu g/m^3$ resulted in a mean estimate of 1,985 premature deaths per year in California (Lloyd/Cackette, 2001). The diesel PM emissions corresponding to the direct diesel ambient population-weighted PM concentration of 1.8 $\mu g/m^3$ is 28,000 tons per year (ARB, 2000). Based on this information, we estimate that reducing 14.11 tons per year of diesel PM emissions would result in one fewer premature death (28,000 tons/1,985 deaths).

Comparing the PM2.5 emissions before and after this regulation, the proposed regulation is expected to reduce PM2.5 emissions by a cumulative amount of 538 tons by the end of year 2022, and therefore prevent an estimated 38 premature deaths (19 - 57, 95 percent confidence interval (95% CI)) by year 2022.

Lloyd and Cackette also estimated that indirect diesel $PM_{2.5}$ exposures at a level of 0.81 $\mu g/m^3$ resulted in a mean estimate of 895 additional premature deaths per year in California, above those caused by directly emitted formed diesel PM. The NOx emission levels corresponding to the indirect diesel ambient PM concentration of 0.81 $\mu g/m^3$ is 1,641 tpd (598,965 tpy). Following the same approach as above, we

[19] Although there are two mortality estimates in the report by Lloyd and Cackette – one based on work by Pope *et al.* and the other based on Krewski *et al.*, we selected the estimate based on the Krewski's work. For Krewski *et al.,* an independent team of scientific experts commissioned by the Health Effects Institute conducted an extensive reexamination and reanalysis of the health effect data and studies, including Pope *et al*. The reanalysis resulted in the relative risk being based on changes in mean levels of $PM_{2.5}$, as opposed to the median levels from the original Pope *et al.* study. The Krewski *et al*. reanalysis includes broader geographic areas than the original study (63 cities vs. 50 cities). Further, the U.S. EPA has been using Krewski's study for its regulatory impact analyses since 2000. (Krewski et al., 2000) (Pope, 1995)

estimate that reducing 669 tons of NOx emissions would result in one fewer premature death (598,965 tons/895 deaths). Therefore, with a NOx reduction of 1,005 tons that is expected to accumulate by the end of 2022, an estimated 2 deaths (1 – 2, 95% CI) would be avoided.

1. Social Benefit - Cost Analysis

As discussed below, staff calculated the value of avoiding one premature death, as well as the estimated cost of control to prevent a premature death

The U. S. EPA has established $6.3 million (in 2000 $) for a 1990 income level as the mean value of avoiding one death (U.S. EPA, 2003). As real income increases, people may be willing to pay more to prevent premature death. The U.S. EPA further adjusted the $6.3 million value to $8 million (in 2000 $) for a 2020 income level. Assuming that real income grew at a constant rate from 1990 and will continue at the same rate until 2020, we adjusted the value of avoiding one death for income growth. We then updated the value to 2005 dollars and discounted values of avoiding a premature death in the future back to the year 2005. The U.S. EPA's guidance of social discounting recommends using both three and seven percent discount rates (U.S. EPA, 2000). Based on these rates, and the annual avoided deaths, the weighted average value of reducing a future premature death, discounted back to the year 2005, is around $5 million at seven percent discount rate, and $7 million at three percent.

The ARB calculates the cost of avoiding a premature death, following these steps:

- For each year, note the annualized cost and the annual premature deaths avoided.
- Allocate a portion of the costs to PM and the rest to NOx, in proportion to the premature deaths prevented by the regulation. Since 96% of the estimated deaths prevented by this regulation would be attributed to PM emission reduction, we allocate 96% of these costs to $PM_{2.5}$ emission reductions and 4% to NOx reductions.
- Take the time value of money into account, by discounting the cost in each year to 2005, using a 3 percent discount rate and a 7 percent discount rate.
- Calculate a cost per premature death avoided in each year.
- Calculate a weighted average of these values, using the weights proportional to the annual premature deaths avoided.
- *Results using a 3 percent discount rate.* The average cost per premature death avoided is about $4 million.[20]
- *Results using a 7 percent discount rate.* The average cost per premature death avoided is about $3 million.

The results presented here are point estimates. Their values are actually uncertain. For example, we reported the confidence interval on the number of premature deaths

[20] The value is the same whether the premature deaths avoided result from reductions of PM or reductions of NOx. That is because the costs allocated to each pollutant are proportional to the number of premature deaths avoided. Thus, the ratio of cost to deaths comes out the same for both pollutants.

avoided. Not all of the uncertainties are quantified, so it would be misleading to calculate and report a confidence interval for the results of the valuation calculations.

2. Health Benefit From Reduced Ambient Ozone Levels

Emissions of NOx and ROG are precursors to the formation of ozone in the lower atmosphere. Exhaust from diesel engines contributes a substantial fraction of ozone precursors in any metropolitan area. Therefore, reductions in NOx from diesel engines in urban areas would make a considerable contribution to reducing exposures to ambient ozone. Controlling emissions of ozone precursors would reduce the prevalence of the types of adverse respiratory effects associated with ozone exposure and would reduce hospital admissions and emergency visits for respiratory effects.

D. Cost-Effectiveness of Proposed Regulation

The estimated average cost-effectiveness of this proposed diesel PM emission reduction regulation is approximately $159/lb of PM reduced annually from fiscal years 2006 to 2010. The costs and emission reductions associated with this regulation and how they were derived are discussed in Appendix C. Both capital costs, such as the purchase and installation of a DECS, and O & M costs, such as incremental fuel cost for fuel DECS, are included in this analysis. This cost-effectiveness does not include a number of benefits and costs, which could not be quantified. These benefits and costs are described in the assumptions section in Appendix C as well.

E. Potential Negative Impacts

Certain potential negative impacts could be associated with elements of this proposed regulation. Those potential negative impacts are discussed below.

1. Creation Of Nitrogen Dioxide By Passive Catalyzed Diesel Particulate Filters

Nitrogen dioxide (NO_2) is a component of NOx and its presence in the atmosphere can be correlated with emissions of NOx. There has been a steady decline in NO_2 values over the years due primarily to the implementation of tighter controls on both mobile and stationary sources. However, statewide emission trends still predict NOx levels of 761 tons/day per year from on-road diesel vehicles by year 2010.

At higher concentrations than are normally found in the atmosphere, NO_2 is an acute irritant. Health effects from prolonged exposure to NO_2 include upper respiratory problems, bronchitis, and pulmonary edema, and NO_2 has been linked to causes of severe asthma and bronchial infections in children.
Measurements of NO_X emissions (NO and NO_2) from heavy-duty diesel vehicles equipped with passive catalyzed filters have shown an increase in the NO_2 fraction, though total NO_X emissions remain approximately the same. Passive catalyzed filters oxidize NO to NO_2, which burns soot captured in the filter. More NO_2 is created than is actually used in the regeneration process and the excess is emitted. In fact, the NO_2 to

NO_X ratios could range from 20 to 70 percent, depending on factors such as the diesel particulate filter system, sulfur level in diesel fuel, and the duty cycle. Diesels without passive catalyzed filters typically emit less than 10 percent NO_2 as a fraction of total NOx.

Based on an ARB study conducted in 2002 (ARB 2002), a cap of 20 percent of NO_2 to NOx emission ratio was established for all verified diesel emission control technologies, to assume that measured NO_2 emission caused no increase in ambient air pollution. In December 2003, the Board made the decision to delay the effective date of the 20 percent NO_2 limit, which was to go into effect on January 1, 2004, to provide more time for manufacturers of DECS to reduce the NO_2 fraction. ARB established a working group comprised of scientists, health professionals, and manufacturers around the world to re-evaluate the limit. Staff is now working on the rulemaking effort to refine the NO_2 specific requirements for verification. ARB staff held a workshop to propose an alternative limit. Details of the workshop can be found at http://www.arb.ca.gov/diesel/verdev/mailoutmsc0504.pdf.

2. Diesel Oxidation Catalysts

Two potential adverse environmental impacts of the use of diesel oxidation catalysts have been identified. First, as is the case with most processes that incorporate catalytic oxidation, the formation of sulfates increases at higher temperatures. Depending on the exhaust temperature and sulfur content of the fuel, the increase in sulfate particles may offset the reductions in soluble organic fraction emissions. Using low sulfur diesel fuel can minimize this effect. Second, a diesel oxidation catalyst could be considered a "hazardous waste" at the end of its useful life depending on the materials used in the catalytic coating. However, diesel oxidation catalysts are usually recycled for their precious metal content and thus are not managed as hazardous wastes in practice. Recycling also reduces any potential impact on landfill capacity.

3. Ash Management

Diesel particulate filter technology may generate a new hazardous waste stream. The carbonaceous component of the PM captured by the filter is burned off when the filter regenerates. Any inorganic components left behind after regeneration as ash in the filter must eventually be cleaned from the filter. Based on preliminary data from two samples, the ash may be classified as hazardous waste because of its zinc content.

Ash collected from a diesel engine using a typical lubrication oil and no fuel additives has been analyzed and is primarily composed of oxides of the following elements: calcium, zinc, phosphorus, silicon, sulfur, and iron. Zinc is the element of primary concern because, if present in high enough concentration, it can make a waste a hazardous waste. Title 22, CCR, section 66261.24 establishes two limits for zinc in a waste: 250 milligrams per liter for the Soluble Threshold Limit Concentration and 5,000 milligrams per kilogram for the Total Threshold Limit Concentration. The presence of

zinc at or above these levels would cause a sample of ash to be characterized as a hazardous waste.

Under California law, it is the generator's responsibility to determine whether their waste is hazardous or not. Applicable hazardous waste laws are found in the HS&C, division 20; title 22, CCR, division 4.5; and title 40 of the Code of Federal Regulations. Staff recommends that owners who install a diesel particulate filter on a vehicle contact both the manufacturer of the DECS and the California Department of Toxic Substances Control (DTSC) for advice on waste management.

DTSC personnel have advised ARB that it has a list of facilities that accept waste from businesses that qualify as a conditionally exempt small quantity generator. Such a business can dispose of a specific quantify of hazardous waste at certain Household Hazardous Waste events, usually for a small fee. An owner who does not know whether or not he qualifies or who needs specific information regarding the identification and acceptable disposal methods for this waste should contact the California DTSC.[21]

X. ISSUES

Over the course of development of this proposal, staff has met with various stakeholders and received written and verbal comments. Although staff has considered each comment, not all issues could be resolved while achieving ARB's goals to reduce diesel PM emissions from public and utility vehicles. Following is a discussion of major outstanding issues.

A. Low Population Definition

Staff has proposed an extended compliance schedule municipalities or utilities located in counties with populations 125,000 or less. Several fleets located in counties with populations over 125,000 but less than 300,000 still have the same fiscal limitations needs as smaller "rural" counties. Counties with population greater than 125,000 but less than 300,000 are listed below (Table 29):

[21] Information can be obtained from local duty officers and from the website: http://www.dtsc.ca.gov.

Table 29. Counties with Populations Between 125,000 to 300,000

County	Population
HUMBOLDT	132,500
NAPA	135,700
KINGS	149,600
MADERA	152,600
IMPERIAL	182,500
SHASTA	185,700
EL DORADO	187,000
YOLO	188,600
BUTTE	235,000
MERCED	239,900
MARIN	257,600
SANTA CRUZ	284,500
SAN LUIS OBISPO	287,000

Several of these counties include urban areas. If these counties are included in the current definition of low population they would account for 17% of the rule's benefit. Staff does not believe these mid size counties should be treated as rural counties with a delayed implementation schedule. Other provision of the rule, such as low use vehicle exemption, and exclusion of dedicated snow removal equipment, may help reduce the cost of the rule to these counties.

B. Biodiesel

The biodiesel industry and entities subject to the Federal Energy Policy Act (EPAct) expressed concerns that implementation of the rule would functionally preclude the use of biodiesel. This is a concern for public fleets such as the military since these agencies are using biodiesel blends in their heavy duty trucks to accumulate alternative fuel credits for compliance with EPAct. This concern was raised several times during outreach activities when no DECS was verified for use with biodiesel blends; however since this time, ARB has verified the Johnson-Matthey CRT with the use of B20 (EO DE-04-006-05). Based on this staff is confident that other DECS manufacturers will also apply for extension of existing DECS verifications to be used with biodiesel blends dispelling the concerns raised earlier in the rulemaking process.

The biodiesel industry has also requested several times to allow biodiesel blends to be considered BACT in the rule. Since ARB is mandating the application of BACT on in-use engines, biodiesel and biodiesel blends could only be considered BACT if the fuel goes through ARB's verification procedure. This would ensure the user that the fuel would carry the same warranty as other DECS against damage to the engine. Other impediments to the use of biodiesel blends have been the lack of fuel specifications for

the neat fuel. ARB has formed a Biodiesel Working Group to facilitate the development of possible biodiesel specifications. This group consists of a broad range of stakeholders, including biodiesel producers, distributors, petroleum refiners, regulatory agencies, and biodiesel end users. Information of this effort can be found at http://www.arb.ca.gov/fuels/diesel/altdiesel/altdiesel.htm

C. Alternative Compliance Plan or Alternative Early Compliance Plan

Several commentors have requested the inclusion of alternative compliance plans or early compliance plans. The rationale behind this request is that some municipalities or utilities have proactively purchased alternative fuel engines or retrofitted their vehicles with BACT. Therefore, the early implementation of BACT should generate credits that would allow delaying the proposed implementation schedule. Staff evaluated this proposal, but believed that implementation of such a provision would be too difficult to enforce. Staff also noted that many municipalities and/or utilities applied BACT to vehicles with the use of grant money. Therefore, no early credit can be given, since most grant money is also tied to emission reduction requirements. Therefore these alternative implementation options were not included in the regulation.

D. Cost to Local Government Agencies

Several government agencies that do not have the ability to collect fees have stated that the cost of compliance for this rule is too high. Staff believes based on the variety of verified DECS available, and the phased-in implementation makes the rule technically feasible and cost effective. The concept of BACT is to give owners several options to choose from whether it is staggering their new vehicle purchases with already complying engines, repowering older vehicles with cleaner engines, or retrofit existing engines with verified technology. BACT is a much more attractive option to accelerated fleet turnover because it does give the owner the choice of less costly options. Staff also tried to stagger implementation schedules that were more in line with fleets' routine plans for vehicle replacement and engine repowering. In addition, staff built in several extensions based on technology unavailability and low population county concerns. Any further relaxing of the proposal would not deliver the near term needs of reducing the public's exposure to diesel PM.

E. Applicability of Proposed Rule to Federal Agencies

The United States Postal Service (USPS) has submitted several comment letters presenting a legal argument that while other governmental fleets may be regulated, federal fleets like USPS may not be regulated until privately-owned fleets are similarly regulated citing section 118(a) of Clean Air Act (CAA). ARB's legal staff determined that USPS's reading of this statute is not consistent with the statute itself and is also inconsistent with other provisions of the CAA. In cases regarding the applicability of state and local regulations to federal agencies, the courts have held that Congress waived its sovereign immunity with respect to independent state or local air pollution

control laws. Therefore, staff has determined that federal fleets including the USPS are subject to the proposed regulation.

XI. SUMMARY AND STAFF RECOMMENDATION

ARB staff recommends the Board adopt new sections 2022, and 2022.1, title 13, chapter 1, article 4, CCR, in its entirety. The regulation is set forth in the proposed regulation order in Appendix A.

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